TECHNICAL BULLETIN No. 873 • AUGUST 1944

Investigations in Erosion Control and Reclamation of Eroded Land

at the

Central Piedmont Conservation Experiment Station Statesville, N. C. 1930-40

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UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE, WASHINGTON, D. C.

IN COOPERATION WITH THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

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Back of every great achievement is knowledge. Back of every successful human undertaking must be exact data for proper guidance of the enterprise.

Farmers of America have undertaken the gigantic task of producing more foods, fats, and fibres than America has ever produced before—vital crops needed for war. These crops—oils and fats, milk and cheese, meat and eggs, and many others—are as essential to winning the war as are tanks, planes, warships, and ammunition. Food is a first weapon of war. And our production goals will likely have to be even higher in order to feed the people of the world made hungry by war.

This puts a tremendous responsibility upon American farmers and a burden on their equipment. But American farmers know how to farm and how to get good crop yields.

It puts a strain on our farm land, too. We do not have enough good land left under cultivation in America to do this job, *unless we use every means at our disposal to increase yields and to protect the soil while we are doing so.* And even then, we may have to bring some new land into cultivation—by irrigation, perhaps, or by drainage. Even some of the older erosion-impoverished lands may have to be put back into use through application of intensive measures for control of erosion.

Unless we take these precautions we must face such unpleasant alternatives as these: (1) We may fail to meet our war crop-production goals, and thereby prolong the conflict, or (2) much land may be laid waste by hazardous overcropping, and in this case the devastation, while less spectacular, would be no less real than that caused by bombs and shells.

These considerations put a premium on knowledge—that special kind of knowledge that will enable farmers to meet the vital war goals without so impoverishing their land that it cannot produce the even greater crops which the next succeeding year of war may demand.

This knowledge, supplementing the training and experience of American farmers as a group, points the way to a successful carrying out of the vital war crop-production enterprise upon which they have embarked and upon which America and a great deal of the world depend, today and tomorrow.

This publication contains much especially significant knowledge as it has been developed through study and research for the central Piedmont area. Crop yields are being increased amazingly by conservation farming methods, and farmers are achieving their staggering war goals without abusing their land.

Briefly, it is a report of technical advances in conservation farming over a 10-year period, showing not only methods used, but the basic factors involved. They are set down clearly and they are authenticated by figures, plates, tables, and other data, concisely presented.

In effect, this report is a manual or handbook for technicians. Any soil and water conservation technician working in the Piedmont region has in his copy of this report a handy pocket guide for determining the exact degrees of slope for terrace channels on certain soils, the vertical fall between terrace crests, the exact expectancy of protection to be derived from various kinds of cover crops on different soils and slopes, the amount of water likely to be conserved from the average rains for crop use under various conditions of slope and soil treatment, and so on. Other reports are planned to provide the same data for technicians in other important farming regions.

They will contain a very large amount of quantitative data that will be particularly useful to agricultural engineers and crop specialists. In these hundreds of measurements, engineers have for the first time available data for computing the probable amount of water that will be delivered by various types of rains falling on the more common surface conditions over large areas of land in the great Piedmont area of the Southeast. And by interpolation, the same data, considered coordinately with similar data from other regions' experiments can be used in making estimates of considerable reliability for many intervening land conditions.

These reports are not for general distribution, but in the hands of the technicians and others who work with the farmers they will be the means of putting into effect on the land more rapidly and more effectively than ever the essential measures to increase production for war.

H. H. Bennett,
Chief, Soil Conservation Service

Washington, D. C. Issued August, 1944

Technical Bulletin No. 873 • August 1944

UNITED STATES DEPARTMENT OF AGRICULTURE WASHINGTON, D. C.

Investigations in Erosion Control and Reclamation of Eroded Land at the Central Piedmont Conservation Experiment Station, Statesville, N. C., 1930-40.[1]

By T. L. COPLEY, *senior soil conservationist,* LUKE A. FORREST, *assistant soil conservationist,* A. G. MCCALL, *senior soil conservationist, and* F. G. BELL, *Chief, Erosion Control Practices Division, Soil Conservation Service.*[2]

THE UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION.

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SUMMARY

The Soil and Water Conservation Experiment Station near Statesville, N. C., was established in 1930 as a cooperative project between the Department of Agriculture and the North Carolina Agricultural Experiment Station. Experimental work was concluded and the Station was closed December 1, 1940.

The Station was established to serve the central Piedmont problem area, extending from central Virginia to the southern South Carolina-Georgia boundary, in which the Cecil soil series comprises approximately two-thirds of the area. Cotton, corn, and tobacco are the leading crops grown in the area. Approximately one-third of the total land area is used as active cropland. Small farm units predominate, and more than one-half the farms are operated by tenants or sharecroppers.

The average annual rainfall at Statesville is 50 inches. Thunderstorms are the predominant type of storms during the summer but winter rains are usually of long duration and low intensity.

A reconnaissance survey, made in 1934, showed 39 percent of the area to be moderately to severely eroded and 29 percent more to have suffered appreciable erosion. Out of the total area damaged by erosion 18 percent was affected by gullying and 3.35

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[1]Submitted for publication February 1944.

[2]Former members of the station staff who contributed to the planning and development of the research program are J. M. Snyder, who had immediate supervision of the soil and agronomic work from 1930 to 1933, F. O. Bartel, E. P. Deatrick, and C. S. Slater.

percent of the total land area had been abandoned because of erosion. Investigations into the causes and consequences of erosion and methods for its control were conducted on plots of various sizes, fields, and terraced and natural watersheds. Meteorological records were kept of the amount, duration, and intensity of each individual storm.

The control plot studies showed that runoff and soil losses were directly related to rainfall intensity, but the magnitude of loss was modified by such other factors as soil type, soil moisture, state of cultivation, degree and length of slope, and extent of protective cover on the soil.

Runoff and soil losses under good vegetal cover composed of sod or woods were of negligible quantities throughout the period of record. Burning of woods litter increased runoff and soil losses to seriously large quantities.

A 4-year rotation of cotton, corn, wheat, and lespedeza decreased the soil losses to less than one-half that of continuous cotton. Cotton in the rotation lost 70 percent and lespedeza but 4 percent as much soil as continuous cotton.

The reduced soil losses from areas under crop rotations, demonstrate the protective effects of crop cover and organic residue for land planted to row crops.

Little difference was recorded in the runoff and soil losses from desurfaced and normal topsoil plots cropped to continuous cotton. Fertilizer applications annually and a 2-year rotation of cotton and corn in which cowpeas were included reduced soil losses on the desurfaced plots to approximately one-half that of continuous cotton on desurfaced soil.

Runoff and soil losses during the summer season comprised the greater portion of losses in all cases of record. A uniform cropping of the experimental plots to continuous cotton for 2 years, following the close of the experiments, showed residual effects of sod crops, but no residual effects from the crop rotations on runoff and soil losses.

The cotton and oganic matter addition plots, showed the beneficial effects of organic matter applied to these Piedmont soils, in the form of woods litter, woods litter compost, and manure. A comparison of terraces of different lengths shows that the soil and water losses were practically the same for the 1,700 and 2,000-foot lengths but considerably less for the 1,400-foot length. Results from terraces with different vertical intervals indicate that for best results the intervals should be approximately 4 feet. For the experimental field F with land slope of 8 to 10 percent and a channel grade of 3 inches, the losses decreased when the interval was reduced to 2 feet, but increased when the interval was increased to 6 feet.

Terrace B-5 with a 6-inch uniform grade lost approximately 3 times as much soil and 50 percent more water than B-4 with a uniform grade of 3 inches. Terraces D-3 with 6-inch grade and D-2 with a 9-inch grade lost decidedly more soil and water than those with 3-inch grades. Terrace D-4 with a variable grade 0-6 inches and D-3 with a uniform grade of 3 inches showed about the same losses. A terrace with 6-inch uniform grade showed 20 percent greater soil loss than the variable grade of 0-6 inches.

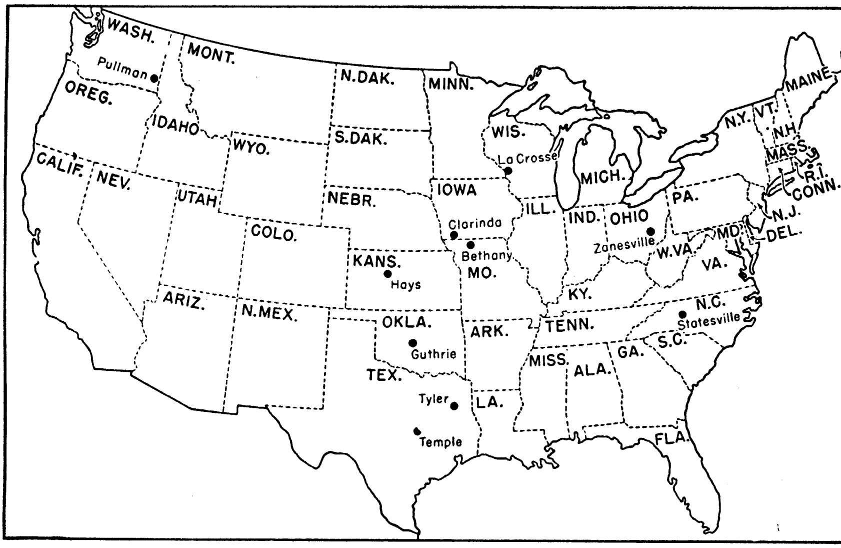
Terrace profile studies indicate that maintenance practices have tended to shift the ridge up the slope to a slight extent. The results of experiments conducted on the station farm are interpreted in terms applicable to the central Piedmont area.

INTRODUCTION

This bulletin is one of a series of reports designed to cover the first decade of experimental work at each of the 10 original soil erosion experiment stations established with funds appropriated by the Congress and carried in the appropriations for the United States Department of Agriculture.

On December 18, 1928, the Buchanan Amendment (*7*)[3] to the Agricultural Appropriation Bill for the fiscal year 1930, appropriating $160,000 for soil-erosion investigations, was adopted by the House of Representatives. Plans were developed for the establishment of experimental work on lands representative of large problem areas of eroding land in various parts of the country. Eventually, 10 experiment stations were organized to serve the several problem areas. (*2, 3, 4, 5*). The location of each of these stations is shown on the accompanying map.

[3]Italic numbers in parentheses refer to Literature Cited p. 66.



Map of United States showing location of 10 soil conservation experiment stations.

The research programs of the stations were designed to investigate the causes of erosion and to determine the most effective and practical methods of checking and controlling soil and water losses from the agricultural lands of the areas. This included experiments with various types of vegetative cover; soil treatments; cultural and cropping systems to determine their comparative effectiveness in preventing erosion; studies of the performance of terraces and check dams of different designs in removing runoff without injury to soil and crops, and attempts to reclaim and revegetate eroded land. The investigations were carried on in cooperation with the State agricultural experiment stations.

In April 1935 the Soil Conservation Act was passed by which the National Government was definitely committed to the policy of soil and water conservation and provision was made for the establishment of the Soil Conservation Service in the Department of Agriculture. The stations, at this time, became an integral part of the research activities of the Service.

The Soil and Water Conservation Experiment Station near Statesville, N. C., was established in 1930 as a cooperative project between the United States Department of Agriculture, the North Carolina Agricultural Experiment Station, and the State Department of Agriculture. Largely through the efforts of R. Y. Winters, former Director of the North Carolina Agricultural Experiment Station, a tract of land adaptable to experimental purposes and representative of the central Piedmont problem area, was leased by the State Experiment Station and made available for experimental purposes. The original plan provided for the operation of the station for a period of 10 years. This plan was adhered to and the final termination of the station work was made on December 1, 1940.

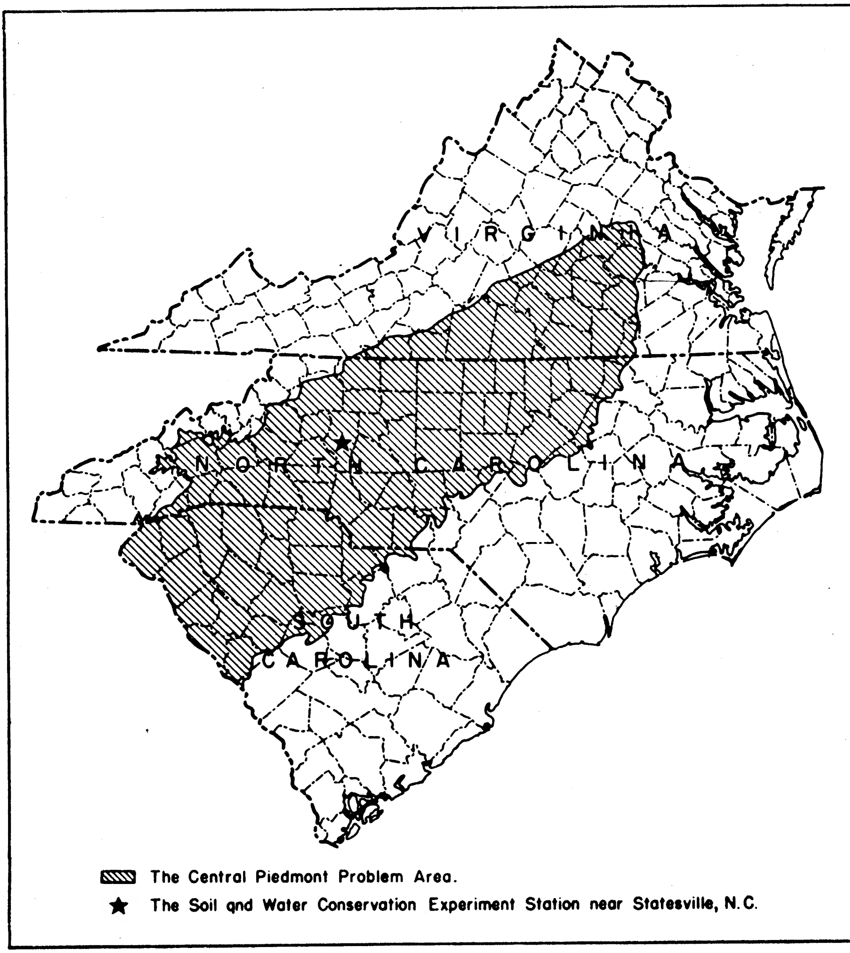


Figure 1.—Location of the central Piedmont problem area and of the Soil and Water Conservation Experiment Station near Statesville, N. C.

THE CENTRAL PIEDMONT PROBLEM AREA

Location and Extent

The Piedmont region of the United States lies between the Atlantic Coastal Plain on the east and the foothills of the Appalachian Mountains to the west. The Piedmont Plateau extends from eastern Pennsylvania across Maryland, Virginia, the Carolinas, and Georgia into east-central Alabama. It is widest in North Carolina which contains 38 percent, or 12,000,000 acres of the region.

That part of the Piedmont extending from central Virginia to the southern South Carolina-Georgia boundary is the area to which the results of the experiments conducted at the Soil and Water Conservation Experiment Station near Statesville, N. C., are most applicable. This area, designated as the central Piedmont problem area, is shown in figure 1.

TOPOGRAPHY

The prevailing topography of the central Piedmont problem area is that of a high plateau dissected by numerous streams, so that the area presents a sharply rolling and uneven surface. In general, the interstream areas are undulating to gently rolling and become hilly near the streams where the slopes are short and broken. Heavily eroded and gullied areas are common, particularly near the larger streams. Elevations range from about 300 feet above sea level on the border of the Coastal Plain to about 1,200 feet in the western part of the area, where the foothills of the mountains begin. At the Statesville station elevations vary from 765 to 975 feet above sea level. The aerial photograph of the station farm located about 10 miles northeast of Statesville, presented in figure 2, illustrates the typical topography of the problem area.

Geologically the greater part of the area is one of the oldest in the world. It dates back to the Archeozoic and Proterozoic eras, which antedate the formation of the Appalachian Mountains. The surface has been worn down probably several hundred feet through geological processes.

SOILS AND VEGETATION

The soils of the problem area were formed by the weathering in place of crystalline rocks and belong to the general group of Red and Yellow soils. They are low in alkalis and silicate silica and high in iron and alumina. They are generally marked by wide differences in texture between the A and B horizons and are usually highly leached and eluviated.

The principal soil series is the Cecil, which comprises approximately two-thirds of the area. This series, together with the Durham, Appling, and Worsham series is derived from granite and gneiss. The two principal types are Cecil clay loam and Cecil sandy loam of which the former is much more important. The latter has the normal profile from which the clay loam has developed through removal of the A horizon by erosion. The normal or mature, undisturbed profile, that of the sandy loam, consists of a very thin surface of leafmold, mainly from deciduous trees, underlaid by a 2- or 3-inch layer of light-textured, or sandy material mixed with enough organic matter to give it a dark color, and this layer in turn is underlaid by a pale-yellow or grayish-yellow sand, loamy sand, or light sandy loam. These two layers constitute the A horizon. The B horizon is red clay containing some sand, and increases in thickness from the northern to the southern part of the problem area where it sometimes attains depths of 5 to 8 feet. The C horizon is reddish or yellowish loose material derived from the disintegration of crystalline gneisses and schists and varies greatly in thickness, in some places attaining depths of 50 to 100 feet.

Other soil series of the problem area are the York, Louisa, and Madison, derived from mica schist and quartz mica schist, and the basic rock soils, Iredell, Mecklenburg, and Davidson. The three soils last named are usually found on flatter areas and have a more regular topography than the Cecil soils. The Helena and Wilkes series, derived from mixed rocks, also occur in the area. A smaller but important soil group is derived from slates and from fine-grain volcanic rocks. The Alamance, Herndon, Georgeville, and Orange (formerly Conowingo)

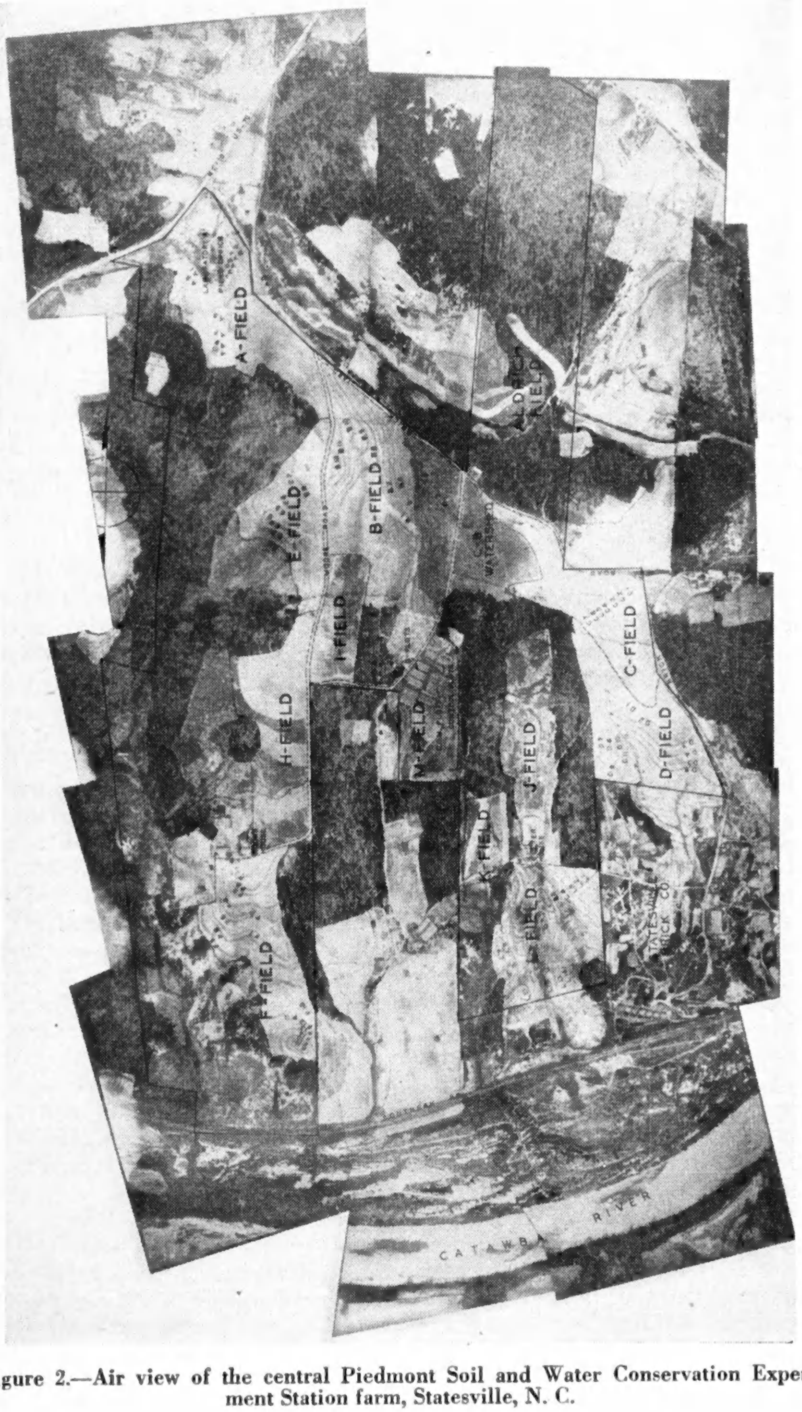


Figure 2.—Air view of the central Piedmont Soil and Water Conservation Experiment Station farm, Statesville, N. C.

series comprise this group. A third group, derived from sandstone and shale, includes the Granville, White Store, Wadesboro, and Penn series, found in the Triassic Basin. The Chesterfield and Bradley soils, which are found on relatively small areas, have subsoils of Piedmont material overlaid by Coastal plain topsoil.

Of the Piedmont soils, the Red soils, including the Cecil, Georgeville, Davidson, Louisa, Madison, Wadesboro, and Penn, and such heavier soils as the Mecklenburg, Alamance, Herndon, and Orange are primarily suited to general farming, including rotations of small grain, hay, or green-manure crops, corn, and cotton. Tobacco is grown on a few of the lighter soils of the series mentioned. The sandier series, such as the Durham, Appling, Granville, White Store, Chesterfield, Bradley, Helena, and York are used extensively for bright tobacco, cotton, corn, sweet potatoes, vegetables, and fruits; hay crops and grains are grown on these soils only to a limited extent. All the problem area was originally timbered. Both pines and hardwoods are found, usually in mixed stands (fig. 3).

Figure 3.—Wooded watershed, central Piedmont Soil and Water Experiment Station, Statesville, N. C. Stand made up of pine about 35 years of age with young hardwoods coming in as understory. General condition of woods in which no recent cutting had been done.

Type of Agriculture

Approximately one-third of the total land of the central Piedmont area is used as active cropland. Cotton, corn, and tobacco are the leading crops grown. Small farm units, with drastic limitations in available farm equipment and power, and poor dwellings, predominate (figs. 4 and 5). This combination of clean-tilled cash crops, small farms, and tenant operation is conducive to a high rate of depletion of soil fertility and of soil loss through erosion.

Figure 4.—Typical farm equipment, Piedmont area.

Figure 5.—Dwelling and home site typical of the small farms of the area.

According to the recent census reports of 67 counties lying wholly or partly in the Piedmont section of the two Carolinas, approximately 2,000,000 acres are devoted to cotton, 1,750,000 acres to corn, and about 300,000 acres are planted to tobacco.

The census also showed a high percentage of tenancy for the Piedmont counties of North and South Carolina, although the percentage for the Piedmont region was not as high as that for the two States combined. The number of croppers and tenants averages about 62 percent for the Piedmont region as compared with 65 percent for the

two States, the percentage being higher in South Carolina than in North Carolina. A high percentage of tenant farmers is conducive to a high rate of soil loss. It is believed that the inclusion of the southern Virginia counties in the above discussions would not materially affect the relative acreages and percentages of tenancy for the problem area as a whole.

CLIMATE

The climate of the Piedmont area is generally mild with abundant, well-distributed rainfall. Table 1 gives climatic data as recorded at 11 United States Weather Bureau stations covering the problem area. Two mountain stations, Wytheville, Va., and Asheville, N. C., are included to represent in a general way western Piedmont conditions, although both lie west of the Piedmont proper. The long and complete records of these stations warrant their inclusion in the table. Appendix table 27 gives the highest, the lowest and the mean temperatures by months and by years as recorded at the Station for the 8-year period 1933-40. The lowest temperature recorded is for January 1940 when the thermometer registered –8.2° F. below zero. The only other subzero temperature registered –2°, occurred in December 1935. The highest temperature, 105°, occurred in September 1939 with a maximum above 100° occurring in 5 of the 8 years of record.

Table 1.—*Climatic data for the Piedmont section of Virginia, North Carolina, and South Carolina*[1]

Weather Bureau station	Length of rainfall record	Elevation	Average annual rainfall	Average annual temperature	Average annual snowfall	Maximum annual rainfall	Minimum annual rainfall
	Years	*Feet*	*Inches*	*°F.*	*Inches*	*Inches*	*Inches*
Richmond, Va.	60	170	41.48	58	13.4	72.1	27.7
Lynchburg, Va.	60	681	40.40	57	15.1	60.5	19.9
Wytheville, Va.	55	2,304	39.40	52	23.2	62.7	21.3
Raleigh, N. C.	58	376	46.11	60	7.9	63.3	32.0
Charlotte, N. C.	52	779	46.50	60	6.5	68.4	29.6
Statesville, N. C.	51	950	49.97	59	8.3	68.1	34.0
Asheville, N. C.	55	2,223	40.37	55	10.9	52.8	22.6
Columbia, S. C.	65	351	42.42	64	2.5	63.1	29.3
Greenville, S. C.	47	1,039	53.39	60	5.3	77.9	33.2
Due West, S. C.	16	711	45.89	62	1.3	82.7	28.8
Spartanburg, S. C.	51	824	49.01	60	4.3	73.9	32.3
Average of records	52	944	44.99	59	8.9	67.8	28.2

Weather Bureau station	Average number of days per year with 0.01 inch or more precipitation	Average date of last killing frost in spring	Average date of killing frost in autumn	Average length of growing season	Average number of thunderstorms: Per year	Average number of thunderstorms: During the 3 summer months per year
	Number			*Days*	*Number*	*Number*
Richmond, Va.	123	Mar. 31	Nov. 2	216	39	24
Lynchburg, Va.	122	Apr. 8	Oct. 27	202	34	23
Wytheville, Va.	143	Apr. 18	Oct. 15	180	37	23
Raleigh, N. C.	123	Mar. 27	Nov. 5	223	41	25
Charlotte, N. C.	123	Mar. 25	Nov. 5	225	43	27
Statesville, N. C.	93	Apr. 14	Oct. 27	196	....	....
Asheville, N. C.	133	Apr. 11	Oct. 21	193	52	35
Columbia, S. C.	111	Mar. 17	Nov. 18	246	45	28
Greenville, S. C.	113	Mar. 30	Nov. 6	221	56	31
Due West, S. C.	103	Mar. 24	Nov. 16	237	74	40
Spartanburg, S. C.	93	Mar. 31	Nov. 3	217	....	....
Average of records	116	Apr. 2	Nov. 2	214	47	28

[1]The data are compiled from records of the U. S. Weather Bureau stations listed.

The average rainfall over the area is 45 inches, as compared with 50 inches at Statesville, N. C. The rainfall at Statesville appears to be slightly more concentrated, as is indicated the fact that it has an average of only 93 days annually with 0.01 inch or more precipitation, as compared with an average of 116 days for the area. It has an annual average of 47 thunderstorms. Of these, 28 occur during the three summer months. The greatest number occur in July, which shows an average of 11. The summer thunderstorms have high intensities and fall during a period when the soil is loose from cultivation. They are therefore conducive to high soil losses. Both the amount and intensity of rainfall, as well as the number of thunderstorms, increase southward over the area from Virginia to the Georgia border. The annual rainfall of Piedmont North Carolina is approximately 5 inches greater than that of Piedmont Virginia, while that of Piedmont South Carolina averages 2 inches greater than that of Piedmont North Carolina. As a result of the increase in the amount and intensity of rainfall southward over the area erosion also tends to increase in this direction.

Table 2.—*Maximum rainfall during short periods in the Piedmont section of Virginia, North Carolina, and South Carolina*[1]

Station	Maximum precipitation during periods of—							
	5 minutes	10 minutes	15 minutes	30 minutes	1 hour	2 hours	24 hours	72 hours
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Richmond, Va.	0.75	1.34	1.69	2.60	4.07	6.33	7.26	9.14
Raleigh, N. C.	.75	1.38	1.74	2.60	3.01	3.19	6.66	9.23
Charlotte, N. C.	.63	1.11	1.56	2.33	2.52	2.67	5.16	8.25
Columbia, S. C.	.74	1.05	1.39	1.81	2.34	3.84	5.50	7.32
Due West, S. C.	.61	1.16	1.58	2.54	3.46	4.66	6.53	8.99
Greenville, S. C.	.52	.90	1.25	2.30	3.43	3.59	8.20	14.14
Average	.67	1.16	1.54	2.36	3.14	4.05	6.55	9.51

[1]The data are compiled from records of the U. S. Weather Bureau stations listed.

Maximum average monthly rainfall over the area occurs during July and August. The South Carolina stations show a minor rainfall apex during February and March, not found in the Virginia and North Carolina records. Statesville is characterized by a March rainfall higher than that of any of the neighboring North Carolina or Virginia weather stations. Figure 6 shows greatest precipitation during 5-, 10-, 30-, and 60-minute periods for several of the principal stations by months. It is evident from these data that greater intensities as well as greater amounts of rainfall are most common in the summer. Table 2 lists the maximum rainfall recorded for periods of 5 minutes to 72 hours at 6 Piedmont stations.

The entire area is subject to occasional high-intensity storms of tropical origin. The most disastrous floods of record resulted from such storms in the Piedmont and adjacent regions in August 1908 and July 1916. On August 25, 1908, a rainfall of 11.65 inches in 24 hours was recorded at Anderson, S. C. On July 14-15, 1916, Effingham, S. C., had 13.25 inches in 24 hours, and Altapass, N. C., had over 22 inches in 2 days. During this same month a record of 31.13 inches total rainfall was established at Kingstree, S. C.

Sectional differences in the distribution, amount, and intensity of rainfall naturally affect the rate of runoff and the resultant erosion.

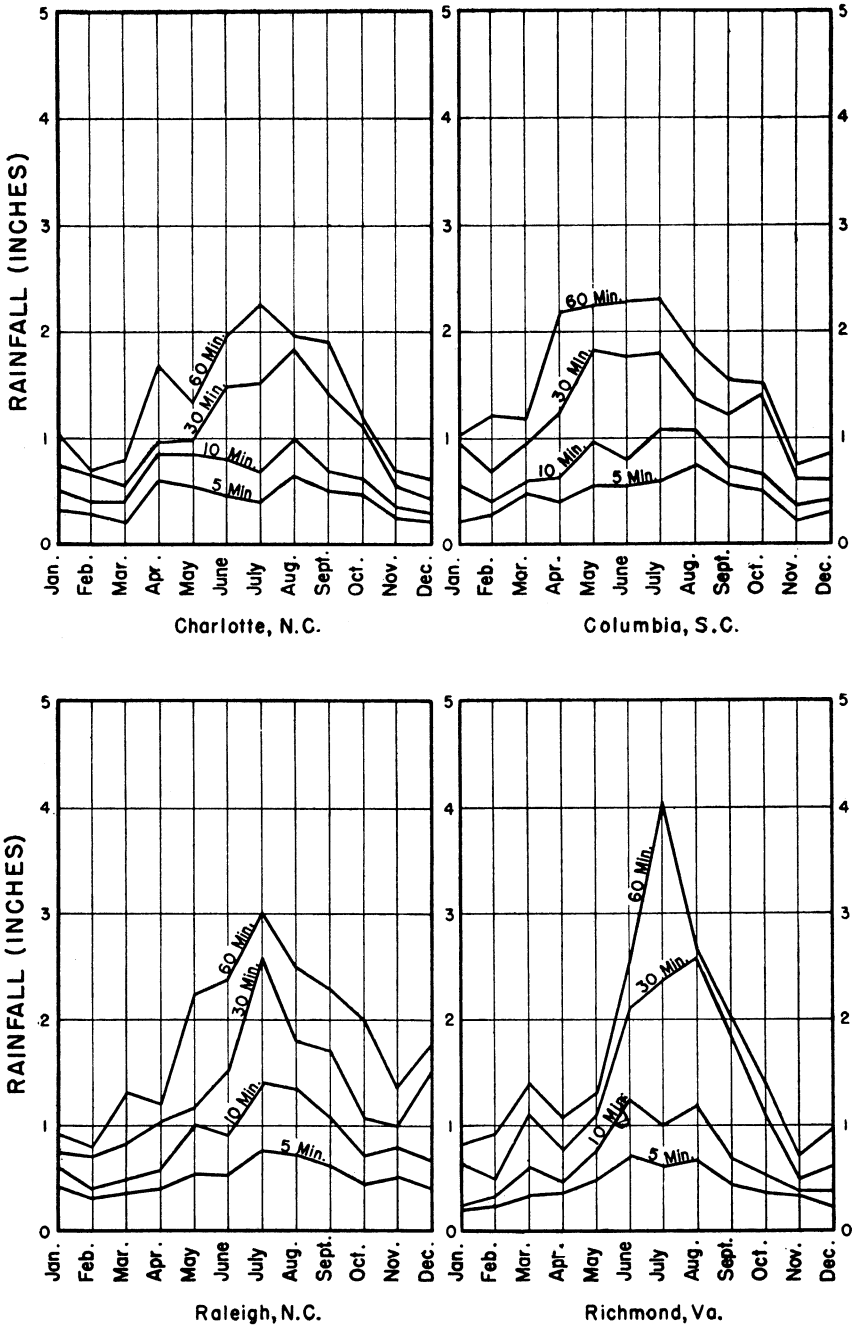


Figure 6.—Greatest precipitation during given intensity periods, by months, as recorded at several United States Weather Bureau stations in the problem area. The data were obtained from records of 26 to 36 years.

Methods of control as developed at the Statesville station may therefore have to be modified for effective application in other parts of the problem area. For example, records at Raleigh, N. C., show that June, July, August, and September are the months of maximum rainfall at that place. During this period an annual close-growing cover crop would be highly effective in reducing soil losses at Raleigh, provided it had made a good growth by June; whereas at Statesville the same type of cover would be less effective because of the great proportionate amount of rainfall occurring in March.

Wind movement and evaporation from a free water surface as recorded at the United States Weather Bureau station at Chapel Hill, N. C. (1921-34) show that the average daily wind movement for the highest month (March) is slightly less than 2 miles per hour, and for the lowest (July) less than 1 mile per hour. Evaporation losses averaged 42.6 inches annually. Evaporation losses per month from free water surface equalled the monthly rainfall of March and April, exceeded rainfall by approximately 1 inch per month until September, and fell below the rainfall by approximately 1 inch per month during the remainder of the season.

Extent and Degree of Erosion

Before the settlement of this region by the early colonists, the simple agriculture of the Indians, carried on in the more level spots, particularly those near streams, caused virtually no soil wastage. Residents can recall the time when streams flowed clear without such violent fluctuations as now occur, and rich bottom lands grew excellent crops with little or no fertilization. Since the extension of cultivation to steeper lands and the destruction of their natural forest cover, the channels of the streams have filled, their beds have widened, and the bottom lands have become subject to overflow or have been made too swampy for cultivation, while others have been ruined by deposits of coarse sand and infertile material washed down by frequent floods. During the past generation many of the streams have been dredged of these deposits in an attempt to reclaim the bottom lands. Too often these efforts were nullified by subsequent erosion, and the lands have again been abandoned or it has become necessary to repeat the dredging operations.

The extent of accelerated erosion in the Southeast was revealed by the erosion reconnaissance survey conducted by the Soil Conservation Service in 1934, which indicated that 35 percent of the total land area of North and South Carolina, or 17,800,000 acres, had been eroded. The eroded land was found to occur mostly in the Piedmont areas of these States, and to a much lesser extent in the western edge of the Coastal Plain and in the mountain sections. The acreages of the land areas in North Carolina that have suffered from different types of erosion are given in table 3, which summarizes the data obtained by the survey. The survey showed, furthermore, that the erosion becomes more severe southward over the problem area, and that in addition to the ravages of sheet erosion vast acreages had suffered serious damage by gullying, which in some areas had forced the complete abandonment of entire fields for agricultural purposes.

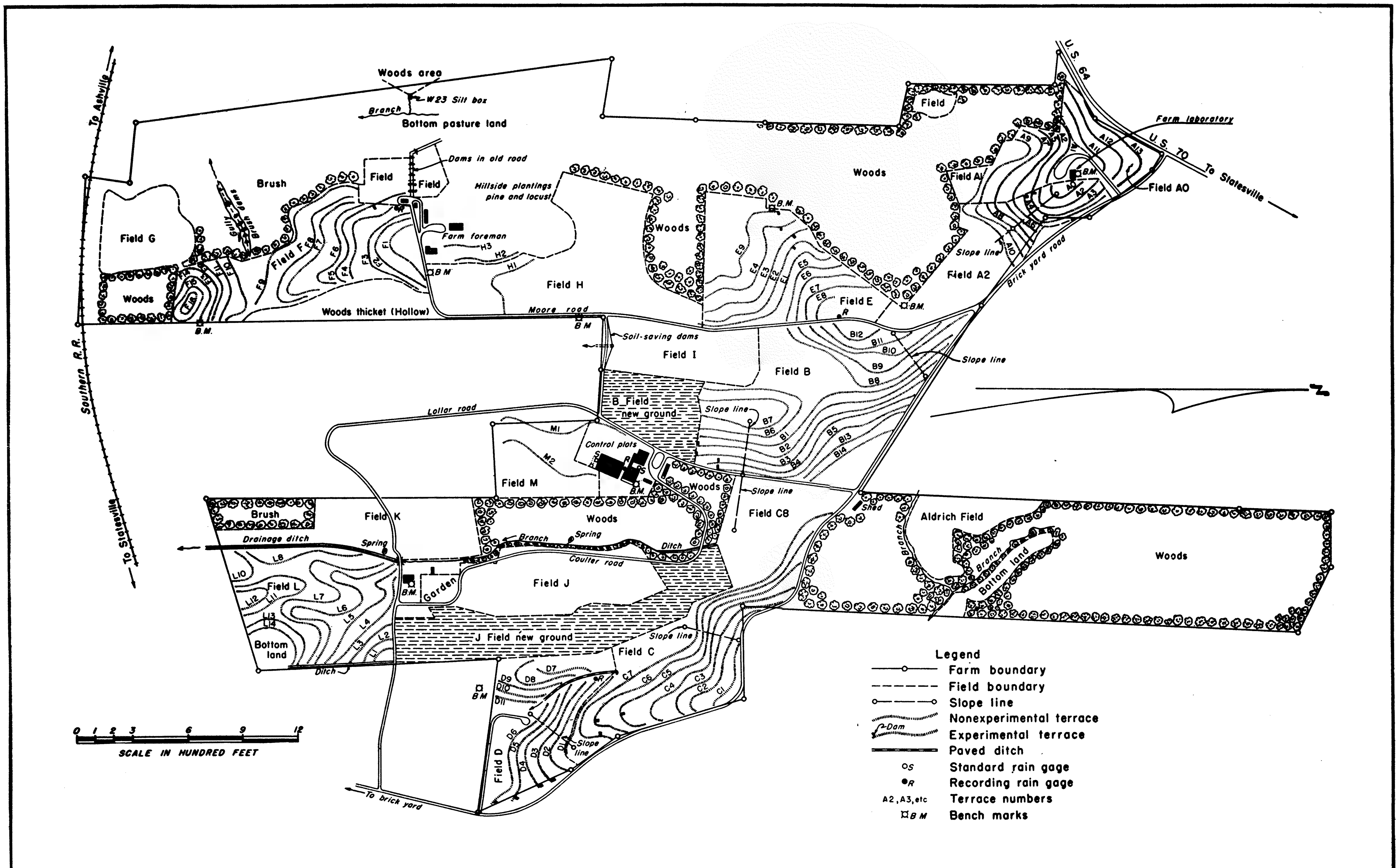


Figure 7.—Soil and erosion map of the Central Piedmont Soil and Water Conservation Experiment Station, Statesville, N. C.

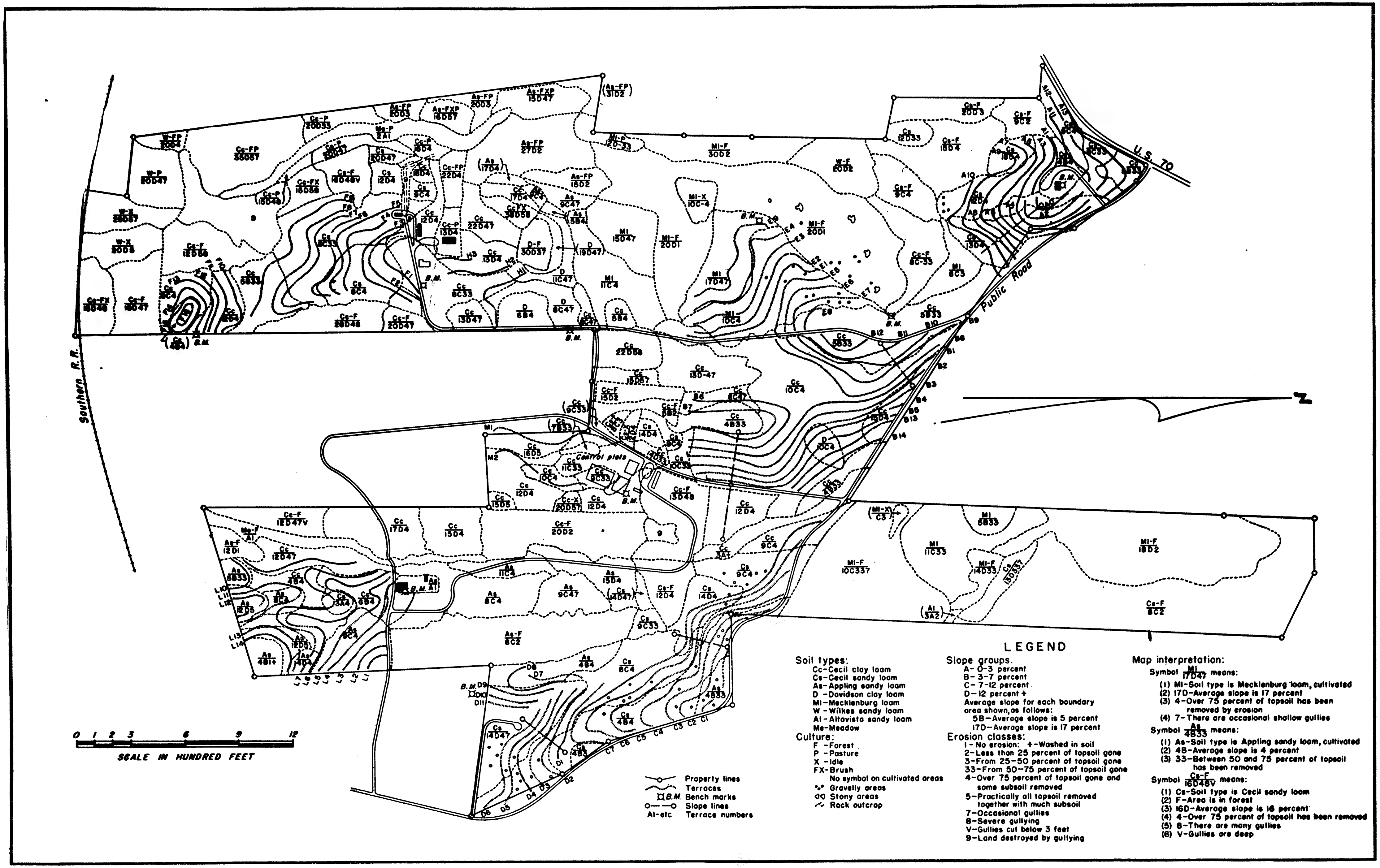


Figure 8.—Map of the Central Piedmont Soil and Water Conservation Experiment Station, Statesville, N. C., showing fields and experimental areas.

Table 3.—*Erosion conditions in North Carolina*

Erosion condition	Acres	Percent
Areas with no appreciable erosion	10,085,000	32.2
Areas with slight sheet erosion (less than ⅓ topsoil lost)	9,000,264	28.8
Areas with moderate sheet erosion (⅓ to ⅔ topsoil lost)	8,480,000	27.1
Areas with severe sheet erosion (over ⅔ topsoil lost)	3,711,035	11.9
Total land area	31,276,299	100.0

THE SOIL AND WATER CONSERVATION EXPERIMENT STATION

Location and Description

The Central Piedmont Soil and Water Conservation Experiment Station was established in 1930, 10 miles southwest of Statesville, Iredell County, N. C., on U. S. Highways 64 and 70. The station farm (fig. 1) contains 304 acres of irregular rolling land with topography typical of most of the Cecil soil areas. Elevations range from 765 to 975 feet above sea level. About half of the farm, including slopes up to 40 percent, has been under cultivation from time to time. Much of the wooded area is even steeper than the cleared part. The farm was selected for the investigational work in soil erosion because it represents the general conditions prevailing in the central part of the Piedmont Plateau with its dominant Cecil soils. A map showing the soil types and erosional condition of the farm is presented in figure 7. The fields and experimental areas as they appeared in 1935 are shown in figure 8.

Agricultural History of the Station by Fields

As nearly as can be determined, field A-O, that part of field A adjoining route 70, was cleared in 1886 and farmed in orchard and truck crops for 25 years and thereafter in general crops. The clearing on the remainder of field A, except 7 acres next to field B, which were cleared about 1850, was begun in 1916, and small patches were cleared intermittently until 1927. The same treatment was given the 7 acres as was given field B, which is described in the following paragraph, except that in 1925 it was taken out of cultivation, allowed to grow up in pines, and cleared again by the station forces in 1930. Although there are only a few bad gullies in this field, virtually all the surface soil had been lost through sheet erosion.

Field B was cleared about 1850, cultivated for 25 years, allowed to grow up in pines, and cleared again about 1900. It had been farmed mostly in cotton with an occasional wheat crop. At the time the station was established this field was badly cut by small gullies on the steeper slopes and had virtually no surface soil left. In the spring of that year about 5 acres in rye had a stand of only a few stalks to the square yard.

Fields C and D were cleared in 1917, burned over, and planted to corn and cotton for about 5 years and were then without a crop for 3 years. Since that time they had been in cotton except for two crops of wheat. The soil on these fields is sandy and harsh with a hard, gritty subsoil almost devoid of humus, and is easily eroded. The field was rather badly gullied on the steeper slopes at the time the farm was acquired, although there was an average of 2 to 3 inches of surface soil left. Plot C-8, the unterraced part of field C, however, has more of a clay-loam type of soil and perhaps, the deepest and richest soil on the farm. This

plot was cleared in 1930 and has been farmed mostly in grain crops with an occasional planting of corn, but it had never been planted to cotton. The depth of soil on the steeper slopes ranges from 3 to 5 inches, with about 15 to 20 inches of alluvial material desposited over the lower areas. A large gully with a maximum width of 30 feet and a depth of 7 feet running down the center of this plot was plowed in during February 1932.

Field E may be divided into two parts, one above terrace E-9 and the other below. The former was cleared about 1925 and has produced two crops of corn and three crops of cotton. It is only slightly eroded, in good condition, and productive. The lower part was cleared about 1900 and has been in cotton almost every year. It is very badly gullied and extremely poor, with practically no surface soil remaining.

The slopes of field F, although irregular, are moderate, and the field except the southernmost extension is fairly fertile. Along the edges, where the slopes increase, it is badly gullied. It was cleared about 1860 and had been mostly in grain and hay crops, with cotton every third year. No corn had been planted up to the time of the establishment of the station.

Field G was cleared about 1885 by deadening the trees and gradually taking out the timber. It was rotated in wheat, oats, rye, clover, and pasture and produced a good crop of lespedeza. At one time it was planted to bluegrass, which was left for several years. An occasional crop of corn was grown. The soil is of the Wilkes series, which is easily eroded except under a good cover. The field was badly gullied about the edges on the steeper slopes, and only the top of the hill was fit for crops.

Field H was cleared in 1888 and buckwheat was grown as the first crop. Thereafter it was put in corn and hay crops for several years and was used later as a hog pasture with one part in orchard. The more level parts of the field were in fair condition, but many bad washes occurred on its irregular slopes, and the steeper hillsides, with slopes up to 40 percent were virtually ruined by gullying. The northern part of the field contained small patches of Davidson soil.

Since being cleared in 1915 field I had had about 10 crops of corn and 6 crops of wheat. The western half of the field had had, in addition, several crops of cotton. The surface soil was virtually all gone from the slopes, which run as high as 23 percent. In 1930 the field was in spring wheat, but the stand was so poor that only a strip about 30 feet wide down the center of the valley was harvested.

The northern part of field J was cleared 40 to 60 years ago. After being pastured for several years it was planted to a more or less definite rotation of oats, cotton, and wheat, with one crop of corn. The land was irregular, badly washed, and extremely poor. The southern part was not so rough and was considerably more fertile, although even here the steeper parts were very poor. It was cleared at the same time as field L and has been given the same treatment.

Field K was cleared about 1890 and has been sown mostly to wheat, with occasional crops of corn and cotton. The soil is a red clay heavier than that of fields J and L but not so badly gullied. Considerable surface soil, however, had been lost.

After being cleared about 1890 field L was farmed, turned out for about 10 years, and cleared again. The crops have been mostly corn

and cotton, with oats occasionally. The land is sandy, harsh, and devoid of humus, and bakes badly. It erodes easily, is badly gullied, and is practically devoid of surface soil on the steeper slopes.

Field M, which was occupied by the plots of the agronomic and soils experiments, was the most fertile field on the farm except possibly that portion of field C occupied by plot C-8. Most of field M was cleared in 1916 and seeded to alfalfa for 3 years and then to red clover. After a single corn crop it was devoted to a rotation of wheat and cotton until 1930.

PURPOSE AND PLAN OF EXPERIMENTS

The investigations at the station were designed to determine the relative importance of the basic factors affecting runoff and erosion and to study means by which satisfactory methods of erosion control might be developed. Information from the results of 3 years' study of a series of experimental plots established at the North Carolina Experiment Station Farm, Raleigh, N. C., by the United States Department of Agriculture, Bureau of Public Roads, in cooperation with the North Carolina Agricultural Experiment Station, 1924-27, [4] [5] [6] reported by Bartel was helpful in planning the studies on effects of length of slope, vegetative cover, cropping practice, and physical and chemical characteristics of the soils on runoff and soil losses.

EQUIPMENT AND METHODS OF INVESTIGATION

Measurements of runoff and soil losses.—Various devices were used at the station for catching or sampling the runoff and eroded material from the plots, terraces, and field watersheds. The plots were fitted either with tanks, which retain all the material coming from the plots, or with sampling dividers, which retain only an aliquot portion. The terraces and field areas were equipped with Parshall flumes and Ramser silt samplers.

Investigations into the causes and effects of erosion and methods for its control were conducted on plots of various sizes, on terraced and natural watersheds, and on gullies, under various experimental conditions, subject to diverse conditions of rainfall, temperature, and wind. The effects of these experimental procedures were determined by measurements of soil and water losses from these areas, which were made by various means, depending on the size and type of area under study. The experimental areas, measuring equipment, and methods of measurement are briefly described in the following paragraphs.

MEASUREMENTS OF RAINFALL

The first requisite toward obtaining a clear picture of runoff and soil losses is a reliable record not only of the total amount but also of the intensity of the rainfall. Three recording gages and one Weather Bureau standard gage were located at strategic points over the farm. Rainfall was measured to the nearest 0.01 inch of depth and to the nearest minute of time.

The rainfall totals by months and by years are given in table 4 together with the annual average precipitation as recorded at Statesville. N. C., by the United States Weather Bureau.

[4] Bartel, F. O. FIRST PROGRESS REPORT ON SOIL EROSION EXPERIMENTS N. C. Expt. Sta. Farm, West Raleigh, Wake Co., N. C. 1925. [Processed.]

[5] ——— SECOND PROGRESS REPORT ON SOIL EROSION AND RUNOFF EXPERIMENTS IN PIEDMONT, NORTH CAROLINA, JUNE 1, 1925 TO MAY 31, 1926. N. C. Expt. Sta. Farm, Raleigh, N. C. 1928. [Processed.]

[6] ——— THIRD PROGRESS REPORT ON SOIL EROSION AND RUNOFF EXPERIMENTS AT THE NORTH CAROLINA EXPERIMENT STATION FARM, RALEIGH, N. C. 1928 [Processed.]

Table 4.—*Rainfall totals by months and by years, Statesville, N. C., 1931-40*[1]

Year	Month												Annual total
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1931	1.76	1.74	4.72	3.39	5.77	2.16	5.62	8.67	1.62	1.31	0.12	8.10	44.98
1932	5.34	2.27	5.55	1.95	2.89	4.12	2.75	5.57	1.49	11.59	4.85	6.73	55.28
1933	1.94	3.58	3.68	2.27	4.64	1.18	4.27	5.83	2.20	1.12	1.27	2.72	34.70
1934	2.17	4.77	6.16	3.32	3.76	3.08	4.31	5.23	4.48	4.47	4.64	2.91	49.30
1935	2.74	3.11	7.75	4.08	2.47	.83	10.22	1.57	2.80	2.03	3.99	1.99	43.58
1936	9.74	4.57	6.82	5.62	.41	3.78	3.73	7.43	4.02	5.28	1.14	6.66	59.20
1937	9.20	2.64	1.20	4.15	2.70	2.74	4.12	6.89	1.82	7.88	2.14	2.04	47.52
1938	2.74	1.28	3.67	2.58	4.89	9.16	9.93	2.40	1.18	.92	5.55	3.46	47.76
1939	2.74	8.84	3.51	2.42	1.41	3.34	7.05	4.95	1.50	1.97	1.24	3.37	42.34
1940	2.49	3.17	3.18	3.16	2.79	3.77	3.53	7.99	2.41	1.65	4.31	2.95	41.40
Total	40.86	35.97	46.24	32.94	31.73	34.16	55.53	56.71	23.52	38.22	27.25	37.98	466.06
10-year average	4.09	3.60	4.62	3.29	3.17	3.42	5.55	5.67	2.35	3.82	2.92	3.80	46.61
55-year average	3.94	4.51	4.85	3.41	4.18	4.45	5.32	5.75	3.91	3.67	2.51	4.05	49.97

[1]From the records of the U. S. Weather Bureau, Statesville, N. C.

Small Plots

The plots.—All of the 62 experimental plots established on the farm were located in field M. The 32 plots from which soil and water losses were measured include 12 control plots, 2 wood plots, 12 cotton-organic-matter plots, and 6 lysimeter installations. Of the 30 plots without measuring devices, 20 were devoted to crop rotations and the remaining 10 were control-plot duplicates used for securing samples, thus obviating the necessity of disturbing the areas under measurement.

Control plots.—Studies on the rate of runoff and soil losses under differing physical conditions and land use were undertaken in a series of small plots known as control plots. This series of 12 plots (fig. 9) on a 10-percent slope of sandy clay loam was established in 1930 and measurements were begun January 1, 1931. Plots 1-10 were of a standard form size 6 feet by 72.6 feet or 1/100 acre. Plot 11 was double length or 1/50 acre, and plot 12 was one-half the standard or 1/200 acre. All runoff and eroded material from the plots were caught in concrete tanks at the foot of the plots. Field M, on which the control plots were located, was cleared in 1916, seeded to alfalfa for 3 years, then to red clover, which was followed by a single crop of corn. After the removal of the corn crop the land was devoted to a rotation of wheat and cotton until 1930. A survey made at the beginning of the experimental period classified the soil as Cecil sandy clay loam from which about 50 to 75 percent of the topsoil had been removed.

Plots 1, 2, and 3 were desurfaced and during the period of record plot No. 1 was kept in continuous cotton while plots 2 and 3 were in a 2-year rotation of corn and cotton. Cowpeas were seeded in the corn, and a winter cover crop of rye and vetch followed the cotton. Plot 4 was kept bare and plots 5, 6, 7, and 8 were in a 4-year rotation of cotton, corn, fall wheat, and lespedeza. The lespedeza seeded in the spring of the wheat year, continued to grow after the wheat was harvested, and was carried over to make the fourth year of the rotation. Plot 9 was kept in permanent sod and plots 10, 11, and 12 were cropped to continuous cotton. Plots 2 and 3 were the only plots fertilized every year, but all cropped plots received an initial fertilizer treatment in 1931. Fertilization of corn, cotton, and wheat was established as a regular practice in 1935 on plots 5, 6, 7, 8, 10, 11, and 12.

Forest plots.—Two forest cover plots A and B were installed in the woods adjacent to the control plots. These plots were similar in all respects to the control plots, except for the woods cover, and were considered as a part of the same series. One of the plots was maintained under natural forest cover; on the other the forest canopy was maintained, but the fallen litter was burned twice a year (fig. 10).

Cotton-organic-matter plots.—A series of twelve 1/100-acre plots was established in 1933 on a 10-percent slope adjacent to the control plots. The plots were spaced 6 feet apart to minimize marginal effects. Ten of them were planted to cotton every year, with variations in the kind and quantity of organic matter applied as a soil amendment during the dormant season, and two were kept unspaded under a permanent litter 2 inches deep.

Strip cropping.—No experiments were installed on the station in which soil and water losses from strip-cropped areas were measured, but observations were made on 4 strip-cropped fields on the station farm. The strips ranged from 50 feet to 150 feet in width and the slopes

Figure 9.—Area devoted to small plots. Control plots in near foreground with duplicate sample plots to the right rear. Organic-matter plots in the left background.

Figure 10.—Wooded plots showing unburned area on left; semiannually burned area on right. Litter on plot on right was burned off each year in December and May.

ranged from 5 to 17 percent. Cotton or corn was grown in the cultivated strips and small grain with spring-seeded lespedeza was grown in the erosion-resisting strips. Under the conditions represented by the station fields, sheet and rill erosion were excessive in all cases and strip cropping, alone, was not adequate for the control of runoff and erosion from these fields.

Lysimeters.—Late in 1934, six lysimeters, patterned after the Musgrave installation at Clarinda, Iowa, were installed at the station (fig. 11). In 1935 three of the lysimeters were planted to corn and three were seeded to Kobe lespedeza.

Terrace Studies

Runoff and soil losses were measured from experimental terraces of various lengths, channel grade, and vertical spacings. Studies were also made of the possibilities of employing closed-channel level terraces for retaining all of the rainfall and thus increasing the available moisture supply. One set of experiments was conducted to determine whether variable grades are necessary for long terraces in the central Piedmont region, in order to provide additional capacity at the lower end of the channel to take care of the additional amount of water that must be handled. The maximum depths of flow in the terrace channels during the principal rains and the corresponding cross-section flow under various conditions of land cover were measured. Observations were made of the amount of deposition in the channels, of terraces of various lengths, grades, and spacings under different crops.

Terrace outlets and gully control.—Efforts were made to devise the

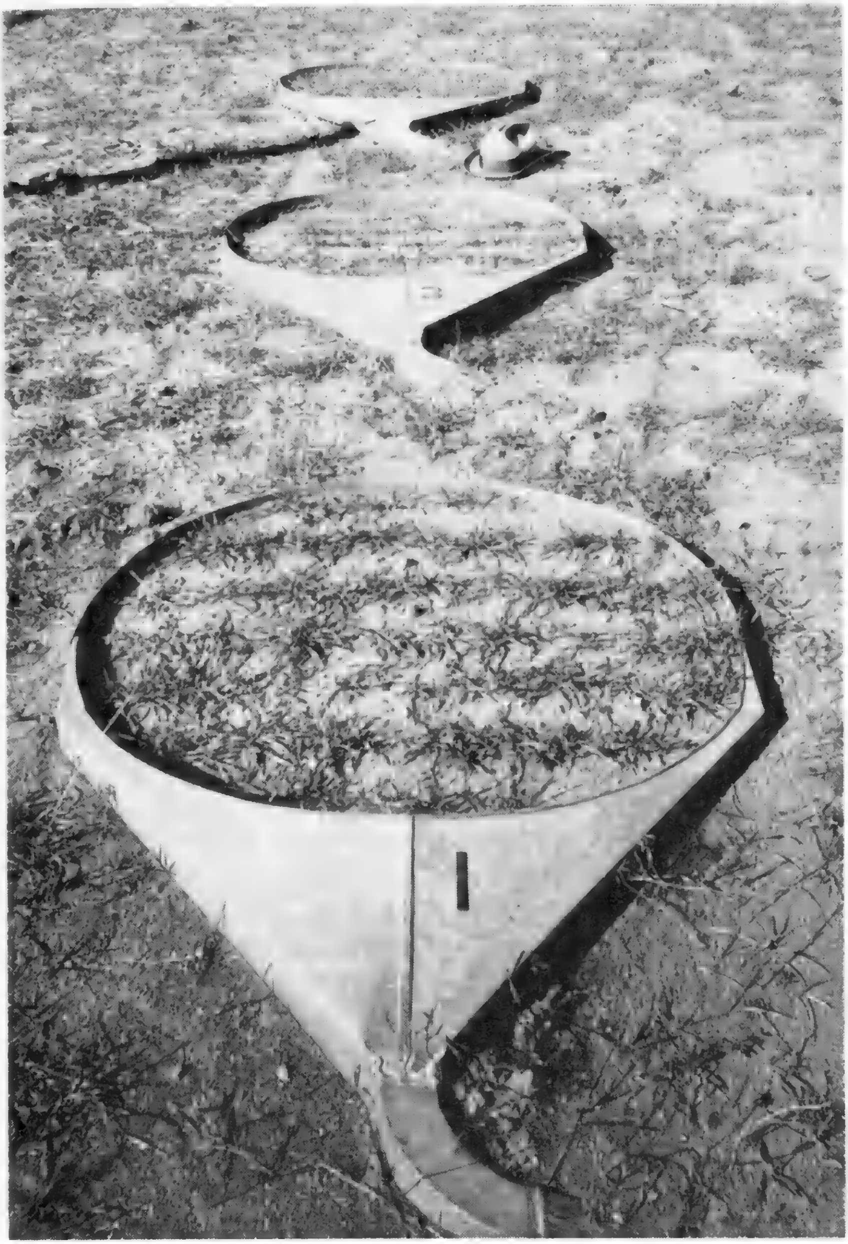


Figure 11.—Surface view of lysimeter installation.

least expensive and most effective method of controlling erosion in terrace outlets on various slopes and in various locations, such as roadside ditches, along fence lines, and in swales or gullies in cultivated fields.

The experiments in gully control were designed to develop inexpensive methods of checking erosion and of filling gullies by means of check dams.

Field and Watershed Studies

Field watersheds.—Measurements were made of the runoff and soil losses from unterraced field watersheds in cultivation and in timber. The cultivated area (C-8) contained 5⅛ acres and was on Cecil soil with an average land slope of 7 percent. The timbered watershed on Appling soil (W-23) had an area of 6 acres on an average land slope of 18.6 percent and was covered with a mixed stand of pine and hardwood trees (fig. 12).

Figure 12.—Typical cover of litter in wooded watershed from which erosion and water losses were measured.

RESULTS OF EXPERIMENTS

Control Plots

Detailed data on average annual runoff and soil losses from the control plots are given in appendix, table 28 and figure 13. These data show that the highest rate of soil and water loss was from plot 4, the bare hard-fallow plot, which lost 66.2 tons of soil per acre, and 29.5 percent of the rainfall as runoff. These losses were more than double those of the next highest, plot 1, which was in continuous cotton on desurfaced soil. Plot 11 is not directly comparable as it is double the length of plot 4. Continuous vegetative cover of grass or woods gave the maximum protection and allowed extremely small quantities of soil or water to escape. Corn-wheat-lespedeza-cotton rotations used on plots 5, 6, and 7, reduced soil losses to less than one-half those from continuous cotton.

The control plots have shown that the runoff and soil losses from bare soil are directly related to the character of rainfall to which it is exposed, and that the direct effect of rainfall on the soil can be greatly modified by vegetative cover. A permanent cover of close-growing vegetation such as grass or woods can completely protect the soil from losses of material consequence. Under continuous cotton, desurfaced soil eroded more rapidly than the normal surface soil, and increased length of slope increased soil losses, but not runoff.

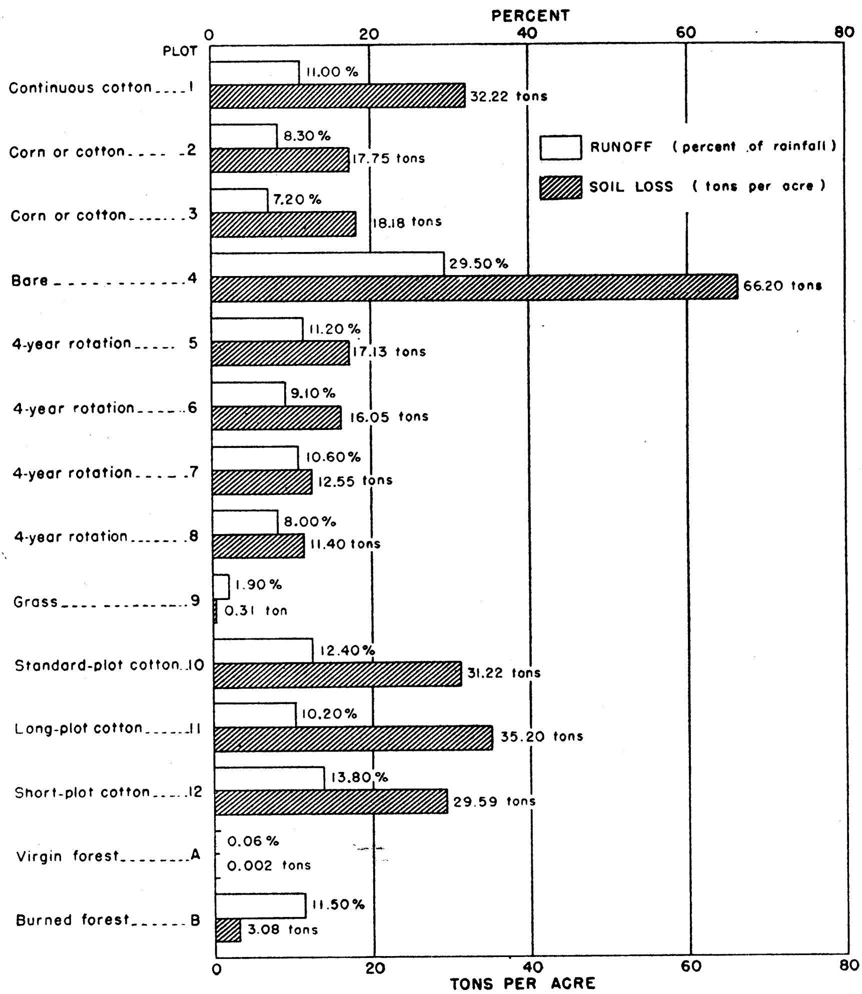


Figure 13.—Average annual runoff and soil losses from control plots.

Rainfall characteristics and water losses from the bare-fallow plot.— In order to interpret the efficacy of control measures on the rate of runoff and soil losses the effect of the rainfall, during the period of study, on bare unprotected soil and from areas under treatment, must

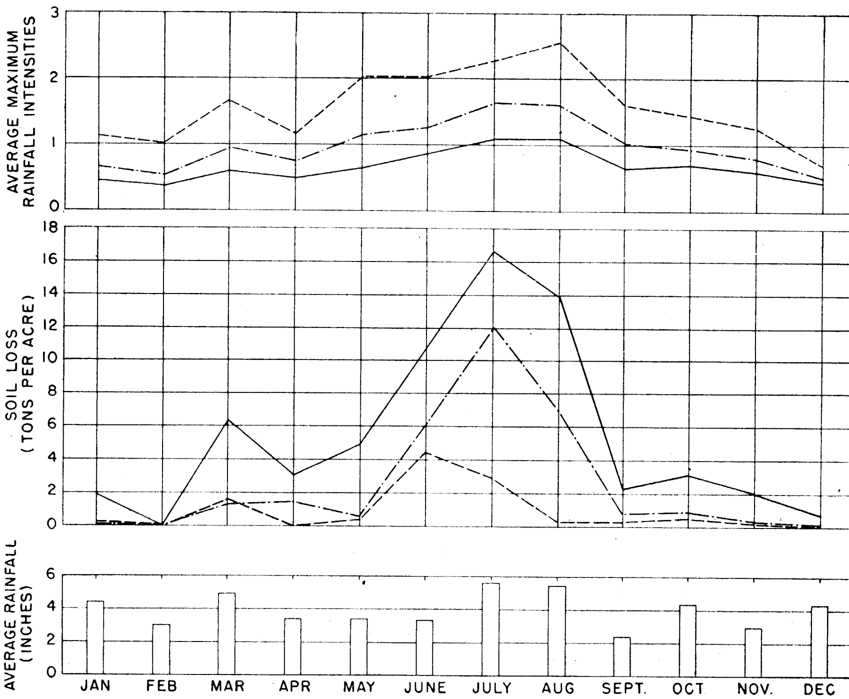


Figure 14.—Monthly average rainfall; maximum rainfall intensity for 5-, 15-, and 30-minute intervals shown by broken, dotted, and solid lines, respectively; and soil loss from bare hard fallow continuous cotton, and rotation plots indicated by solid, dotted, and broken lines, respectively.

Table 5.—*Monthly average maximum 5-minute, 15-minute, and 30-minute intensities for all rains causing soil losses, 1931*

Month	Average number of rains	Average maximum intensity		
		5-minute	15-minute	30-minute
		Inches	*Inches*	*Inches*
January	11	1.12	0.65	0.46
February	2	1.02	.52	.37
March	25	1.66	.93	.60
April	20	1.16	.75	.50
May	28	2.03	1.14	.65
June	34	2.03	1.26	.86
July	35	2.27	1.62	1.10
August	39	2.55	1.60	1.10
September	16	1.60	1.02	.64
October	14	1.45	.93	.71
November	14	1.25	.80	.60
December	15	.70	.51	.42

be known. Plot 4, of the control plot series, was maintained in a bare fallow for the duration of the study and the runoff and soil losses measured from this plot have been used as a check. The average rainfall, maximum intensities for 5-, 15-, and 30-minute intervals, and soil loss by months from the bare hard-fallow, the continuous cotton, and the rotation plots, are shown in figure 14 and table 5. It is evident that the soil losses are not directly proportionate to the total amount of rainfall each month, but are more closely associated with rainfall intensity. However, both factors have influenced soil losses, since these losses increase rapidly when both amount and intensity of rainfall increase. Increased amount of rainfall with declining intensities resulted in a decrease in the average soil loss for the month of December. In appendix table 28 will be found a detailed record of the runoff and soil losses from the several control plots, caused by all rainstorms that produced runoff from the bare hard-fallow plot 4 of the series.

In table 6 data on all the rains causing runoff from plot 4 have been grouped according to total amounts, and maximum intensity rates. The total soil and water losses for each grouping is also shown. These data show that the rains with intensities exceeding 1.5 inches per hour, even for a 5-minute period (less than one-half the total rainfall causing erosion) have caused 89.2 percent of the total soil loss. Soil loss per acre-inch of runoff progressively increased from 1.87 tons for the 0-1.5-inch-per-hour maximum intensity to 8.10 tons for intensities in excess of 4.5 inches per hour for a 5-minute period. Tons of soil loss per acre-inch of runoff from rains when grouped by amounts of rain per storm, showed a decrease from 6.15 tons per acre-inch for 0-1 inch rains, to 1.75 tons per acre-inch for rains of 3 inches or more. These data indicate that the rains of large cumulative total amounts are typically of relatively long duration and of low intensity.

From table 7 it is evident that the class of storms causing the greatest total soil loss per year are those of 1- to 2-inch total amounts with intensity in excess of 1.5 inches per hour for at least a 5-minute period. However, storms in excess of 2 inches total rainfall and with 5-minute intensities of 3.0 inches or more per hour have occurred 10 times during the period, 1931-38, or on an average of once a year. These 10 storms show an average soil loss of 9.8 tons per acre. The station records show that it is not an uncommon experience to lose as much soil at one time from a storm of this type, as from all the remaining total rainfall for the year. Inasmuch as an excessive rain of this type will occur on the average at least once a year no plan of conservation can be considered fully adequate if it lacks the ability to control soil losses which would be experienced from these storms.

Slope length and soil and water losses.—Plots 10, 11, and 12 of the control plot series were used to determine the influence of length of slope on soil and water losses. Plot 10 was 72.6 feet in length; plot 12, 36.3 feet; and plot 11, 145.2 feet. Plot 10 was known as the standard plot, being equal in length to other plots of the control plot series; plot 12 was called the short plot, and plot 11, the long plot. Plot 12, the short plot, showed the lowest rate of soil loss but the highest rate of runoff. Figure 15 shows the percent of runoff from the three plots for

Table 6.—*Total rainfall causing runoff on control plot No. 4 (bare-fallow) in relation to runoff and soil losses by classified groups, 1931-38*

Rainfall group	Rains		Rainfall		Runoff			Soil loss		
	Number	Percent of total	Amount	Percent of period total	Amount	Percent of group total	Percent of period total	Per acre	Per inch of runoff	Percent of period total
		Percent	*Inches*	*Percent*	*Inches*	*Percent*	*Percent*	*Tons*	*Tons*	*Percent*
Amount:										
0-1 inch	167	60.95	86.14	28.74	25.60	29.72	22.48	157.47	6.15	29.94
1-2 inches	68	24.82	99.67	33.25	41.32	41.46	36.28	210.69	5.10	40.06
2-3 inches	34	12.41	84.39	28.15	32.44	38.44	28.48	132.25	4.08	25.14
More than 3 inches	5	1.82	29.54	9.86	14.54	49.22	12.77	25.49	1.75	4.85
Total	274		299.74		113.90			525.90		
Inches per hour for 5-minute period:										
0-1.5	151	55.11	131.02	43.71	30.05	22.94	26.38	56.91	1.87	10.82
1.5-3.0	77	28.10	97.27	32.45	41.89	43.07	36.78	196.82	4.70	37.43
3.0-4.5	32	11.68	51.46	17.17	30.27	58.82	26.58	177.47	5.86	33.75
More than 4.5	14	5.11	19.99	6.67	11.69	58.48	10.26	94.70	8.10	18.01
Total	274		299.74		113.90			525.90		

Table 7.—*Storms causing runoff on the bare-fallow plot by amount and 5-minute intensity group, 1931-38*

Amount group	Intensities															
	0-1.5 inches per hour for 5-minute period				1.5-3.0 inches per hour for 5-minute period				3.0-4.5 inches per hour for 5-minute period				More than 4.5 inches per hour for 5-minute period			
	Rains	Runoff	Soil loss		Rains	Runoff	Soil loss		Rains	Runoff	Soil loss		Rains	Runoff	Soil loss	
			Per acre	Per inch of runoff			Per acre	Per inch of runoff			Per acre	Per inch of runoff			Per acre	Per inch of runoff
	Number	*Inches*	*Tons*	*Tons*	*Number*	*Inches*	*Tons*	*Tons*	*Number*	*Inches*	*Tons*	*Tons*	*Number*	*Inches*	*Tons*	*Tons*
0-1 inch	108	8.72	21.76	2.50	38	7.92	50.09	6.32	16	6.68	63.05	6.44	5	2.28	22.57	9.90
1-2 inches	27	10.82	22.18	2.05	26	17.71	100.11	5.65	9	8.44	53.89	6.38	6	4.35	34.51	7.93
2-3 inehes	15	10.44	12.97	1.24	12	11.49	40.61	3.53	4	5.45	41.05	7.53	3	5.06	37.62	7.43
More than 3 inchcs	1	.07			1	4.77	6.01	1.26	3	9.70	19.48	2.01	0			

each year. It is evident from this figure that the long plot has had the least runoff every year for the period of record. The standard plot lost slightly more runoff water than the short plot in 1935 but con-

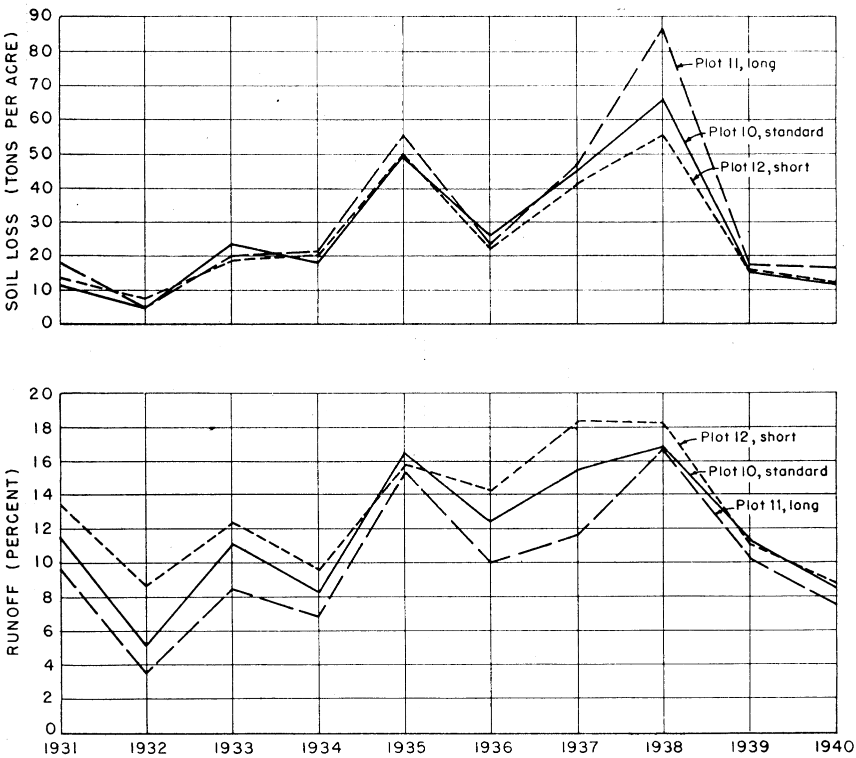


Figure 15.—Soil and water losses from plots of different lengths.

sistently less for all other years, except 1939 when the losses from the two were equal. The runoff from all three plots was almost equal in 1935, 1938, and 1939. Soil losses per acre by years for the three plots, also are shown in figure 15. No contrast trend of differences between the plot soil losses is apparent. Wide differences in soil loss for the year 1938 have been important factors in determining the final average amounts of loss for the plots. In 1933 and 1936 the standard plot lost the most soil, and in 1932 the short plot had the highest losses. The losses from the long plot were highest during each of 6 years, but the differences between the rates of loss for the three plots was very small for the year 1939. The average annual soil and water losses for the three plots, as given in figure 15 show that the long plot lost more soil per acre but less runoff than either the standard length plot or the short plot.

Monthly and seasonal soil losses.—In order to determine the monthly

and seasonal effect of rainfall on soil and water loss from various cropland conditions this information has been tabulated for plots 4, 5, 6, 7, 8, and 10 which include bare fallow, continuous cotton and the four crops of the 4-year rotation. These plots are a part of the control plot experiment which has been described in a previous paragraph. Data on this monthly rainfall, runoff, and soil loss are given in table 8. Rainfall is well distributed throughout the year with precipitation somewhat heavier than average in July and August and somewhat lighter than average for September and November. These data show very definitely that the greater part of the soil loss and runoff from bare land and from land in row crops, occurs during the three summer months of June, July and August. On the bare plot 45 percent of the annual runoff and 63.6 percent of the annual soil loss occurred during the summer, while on the cotton and corn plots the water loss ranged from 57 to 64 percent and the soil loss from 72 to 84 percent of the total soil loss. It will be noted also that for the rotation as a whole approximately 72 percent of the total soil loss occurred during the three summer months. Of the amount of soil removed during this entire period approximately 95 percent came from the cotton and corn plots. The percent of total runoff from wheat and lespedeza in the 4-year rotation was greater for the summer months but soil loss was greater during the spring months.

During the winter period rainfall was 24 percent of the annual amount. The runoff and soil loss, for this period, however, were only a small percent of the annual total. Winter runoff varied from 10 percent to a minimum of 6.2 percent while soil loss ranged from 12.1 percent to 0.5 percent. While the marked increase in soil loss during the summer months may be influenced somewhat by the increased amount of rainfall during the season, it is evidently the result of the high intensities of the summer rains. These monthly intensities are shown in figure 14 and are described in the accompanying discussion.

This seasonal variation in soil loss indicates the period during which protection is most needed and also shows the value of close growing crops in conserving soil. Since row crops are grown during the vulnerable periods it is highly important that as much protection as possible be provided by means of crop residues, contour tillage and terracing. The greatest effect of winter cover is not exerted during the winter months but in the spring season. Rainfall was relatively high in amount but intensities were low during this winter period and average soil losses from continuous cotton were less than 1 ton per acre. Winter cover, if turned under in March, even if it prevented the entire winter soil loss, would not be as effective in soil saving as cover growing on the land through March and April or the utilization of cover in the form of a plant residue protective cover on the surface during this period. A decrease of 50 percent in soil losses at this time would be much more valuable than the prevention of the entire winter losses. That it is possible to bring about a decrease in soil losses by cover cropping, is proved by the fact that in one experiment, made in connection with the Piedmont investigation, there was a loss of 3.42 tons per acre when cotton was grown continuously, as compared with 1.41 tons per acre when cotton followed lespedeza. Benefits are dependent, of course, upon the amount of growth of the cover during the winter and the time and manner of its disposal in the spring.

Table 8.—*Average monthly runoff and soil loss from the bare-fallow plot, plots in continuous cotton, and plots of 4-year rotation, 1931-38*

Month	Rainfall	Bare fallow		Continuous cotton		4-year rotation								Average of 4-year rotation	
						Cotton		Corn		Wheat and lespedeza		Lespedeza			
		Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	Inches	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*	*Inches*	*Tons*
January	4.45	0.77	1.92	0.24	0.18	0.11	0.01	0.32	0.32	0.47	0.51	0.13	0.04	0.26	0.22
February	3.00	.04	.02	.01	....	....	....	.01	....	.01	....	....	....	.01	....
March	4.91	1.02	6.39	.26	1.37	.07	.88	.30	2.78	.54	1.92	.19	.96	.27	1.64
April	3.42	.69	3.08	.29	1.49	.14	.14	.46	1.46	.26	.22	.20	.17	.27	.50
May	3.48	.76	4.90	.14	.56	.08	.39	.15	.70	.45	.52	.30	.19	.25	.45
June	3.38	1.29	10.72	.59	6.14	.57	5.39	.45	4.77	.81	.62	.13	.12	.49	2.72
July	5.62	2.50	16.64	1.32	12.05	1.19	8.59	1.18	8.56	1.34	.76	.41	.02	1.03	4.48
August	5.47	2.63	13.89	1.38	6.98	1.31	4.12	1.67	7.43	1.44	.30	.72	.04	1.28	2.97
September	2.45	.74	2.35	.31	.83	.26	.41	.23	.89	.18	.02	.05	....	.18	.33
October	4.32	1.94	3.19	.69	.96	.66	1.02	.28	1.12	.36	.05	.10	.01	.32	.55
November	2.97	1.06	2.09	.38	.39	.34	.68	.11	.17	.22	.02	.03	....	.18	.22
December	4.33	.67	.85	.14	.16	.21	.10	.09	.18	.10	.01	.05	....	.11	.07

Table 9.—*Losses from selected control plots for 8-year period 1931-38, Statesville, N. C., Conservation Experiment Station: Cecil sandy clay loam, 10-percent slope, average rainfall 47.8 inches*

Plot No.	Crop system	Treatments and total fertilizer applications for the 8-year period	Total runoff and soil loss for the 8-year period			Average annual loss	
			Runoff	Soil loss		Runoff	Soil
			Inches	*Tons*	*Acre-inches*	*Inches*	*Tons*
1	Continuous cotton, no winter cover except cotton stalks	Desurfaced; 600 pounds 5-10-3	42.2	257.7	1.7	5.3	32.2
2	Rotation corn and cowpeas, cotton with winter cover of rye and vetch	Desurfaced; 2,000 pounds 5-10-3; do	31.7	142.2	.95	4.0	17.8
3	Rotation cotton with winter cover of rye and vetch, corn and cowpeas	Desurfaced; 2,000 pounds 5-10-3; do	27.7	145.4	.97	3.5	18.2
10	Continuous cotton, no winter cover except cotton stalks	Normal surface; 600 pounds 5-10-3; 2,400 pounds 4-10-4	46.0	249.8	1.7	5.8	31.2
4	Bare, hard-fallow	Normal surface scraped 4 times each year to remove weeds	112.9	529.6	3.5	14.1	66.2

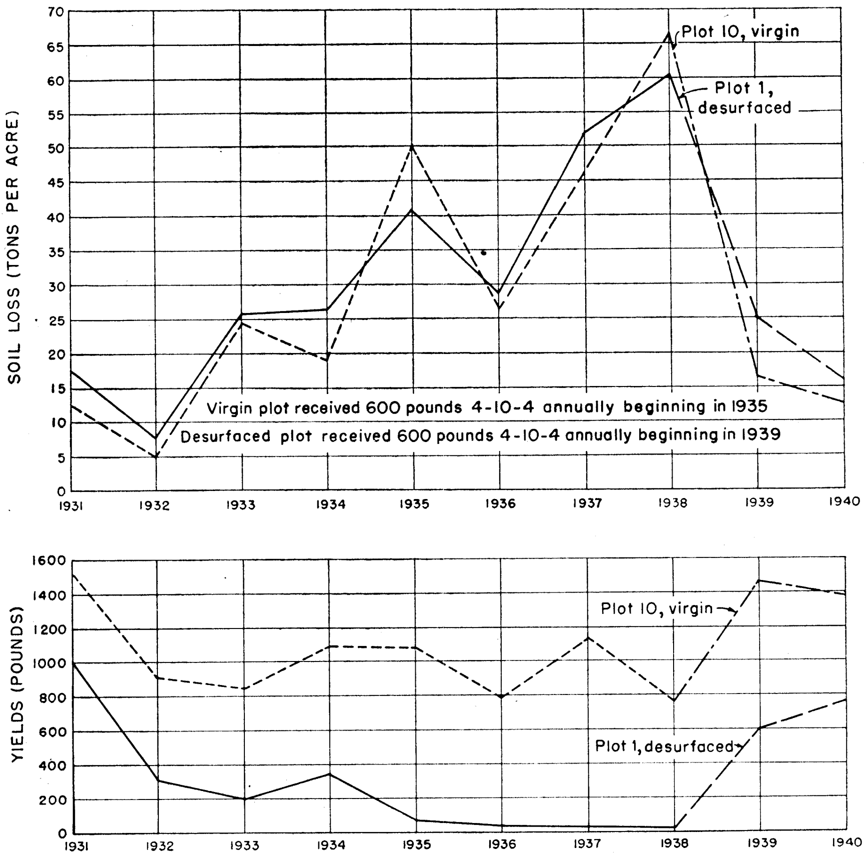


Figure 16.—Soil loss and crop yield on virgin plots as compared to desurfaced plots.

Degree of erosion, and soil and water losses.—At the beginning of the work at the Statesville station, plots 1, 2, and 3 were desurfaced by the removal of the top 6 inches of soil, but because of the variables introduced by differences in cropping systems and fertilizer treatments they are not directly comparable. Plot 1 was devoted to continuous cotton and received a single application of 600 pounds of a 5-10-3 fertilizer in 1931; while plots 2 and 3 were devoted to a rotation of cotton and corn with cowpeas, rye and vetch being employed as cover crops and fertilizers being applied each year at the rate of 600 pounds per acre to the cotton and 400 pounds to the corn. Although plot 1 cannot be compared with the two desurfaced plots 2 and 3, it is possible to compare the behavior of the continuous cotton desurfaced plot 1 with the continuous cotton plot No. 10 (fig. 16) and with the bare hard-fallow plot 4, for the 8-year period of record. However, attention should be called to the fact that normal surface plot 10 had the benefit of an application of a total of 3,000 pounds of commercial fertilizer for the 8-year period while the desurfaced plot 1 received only 600 pounds applied in 1931 at the beginning of the period. Table 9 summarizes the losses from these selected plots for the 8-year period, 1931-38.

During the entire 8 years covered by the experiment plot No. 4, the bare hard-fallow plot, lost 3.5 inches of topsoil, as compared with 1.7 inches lost by desurfaced plot 1 and 1.5 inches by the normal surface soil plot 10, both of which were planted continuously to cotton. It will be seen, therefore, that when the entire 8-year period is considered, the loss of soil from the desurfaced plot growing cotton continuously is only slightly greater than that from the normal surface devoted to continuous cotton and that the loss from the bare hard-fallow plot was approximately twice that from the plots planted to continuous cotton.

Each of the desurfaced plots 2 and 3 devoted to a rotation of corn and cotton and protected by a winter cover of rye and vetch, lost slightly less than an acre-inch of topsoil during the two 4-year rotation cycles.

Vegetative cover, soil losses, and runoff.—Vegetative cover is an effective means of controlling runoff and soil losses. A comparison of the losses from control plots with various types of cover and plots with bare soil (table 10) shows progressively effective results with each increase in quantity or quality of the cover used. The loss from continuous cotton, plot 10, was but half that of bare soil, plot 4, and the use of a rotation including small grain and lespedeza, reduced soil loss to less than one-fourth that of bare soil. Permanent cover of sod or woods gave the maximum of control, as both soil loss and runoff were of negligible quantity. The apparently higher losses on plots under permanent sod when compared to plots in virgin woods was caused by the soil losses suffered during the period of establishment of the grass cover. Table 11 shows the soil losses and runoff for the three critical months of May, June, and July, of 1931, the year of establishment. It will be observed that the losses during the early months of establishment accounted for most of the total soil loss for the year and for the entire period of record. The average soil loss for the period, including the year of establishment, 1931, is 31 times as great as the average for the years, 1932-38, following the establishment of good sod. However, it can be seen that the losses of soil and runoff water were of negligible quantities in either case.

Table 10.—*Average annual runoff and soil loss from control plots under various covers, 1931-38*[1]

Plot designation	Cover	Rainfall	Runoff		Soil loss per acre
		Inches	*Inches*	*Percent*	*Tons*
4	Bare soil	47.80	14.12	29.5	66.20
10	Continuous cotton	47.80	5.74	12.4	31.22
5, 6, 7, 8	Crop rotation	47.80	4.77	10.0	14.41
9	Permanent sod	47.80	.91	1.9	.31
A	Virgin woods	46.47	.03	.06	.002

[1]The data for plot A represent the average results for the period 1932-40.

Crop rotation, runoff, and soil losses.—A 4-year rotation of corn, wheat, lespedeza, and cotton was run on plots 5, 6, 7, and 8 of the control series. The crops were arranged on the plots so that each crop

Table 11.—*Soil losses and runoff from control plot 9 for the 3 months during which grass was becoming established, as compared with the total annual losses for the year and for the 8-year period 1931-38*

Period	Rainfall	Runoff		Soil loss per acre
1931	*Inches*	*Inches*	*Percent*	*Tons*
May	5.77	1.73	29.9	1.16
June	2.16	.43	20.1	.20
July	5.62	2.27	40.4	.80
3-month total	13.55	4.43	32.7	2.16
12-month total	44.98	6.48	14.4	2.38
1931-38 average	46.49	.91	1.9	.31
1932-38 average	48.20	.10	.2	.01

Table 12.—*Average annual rainfall, runoff, and soil loss from the crops of a 4-year rotation on control plots, 1931-38*

Crop	Number of crops	Rainfall	Runoff		Soil loss per acre
		Inches	*Inches*	*Percent*	*Tons*
Corn	8	47.80	5.12	10.7	28.69
Wheat	7	48.20	6.49	13.5	5.61
Lespedeza	9	47.48	2.51	5.3	1.52
Cotton	8	47.80	4.97	10.4	21.82
Continuous Cotton	8	47.80	5.74	12.4	31.22
Rotation average		47.80	4.77	10.0	14.41

appeared each year. The corn in the rotation followed cotton without a winter cover crop. Wheat was sown in the fall as soon as the corn was removed and the lespedeza was seeded in the wheat so that good winter cover was provided on each plot except on the one in cotton. It will be seen from table 12 that the cotton grown in rotation lost soil equal to 70 percent of the amount lost from continuous cotton grown on plot 10, used as a check. Corn following cotton without a winter cover crop lost 92 percent of that lost by the continuous cotton, and wheat and lespedeza lost 18 percent and 5 percent, respectively. The runoff from wheat was the highest for any crop in the rotation, averaging 13.5 percent as compared to 12.4 percent for continuous cotton and 10.7 percent, and 10.4 percent for corn and cotton, respectively, when grown in rotation. Lespedeza was the most efficient in controlling both soil and water losses, allowing but 5.3 percent runoff, and 1.52 tons per acre soil loss per year. The 4-year rotation materially reduced soil and water losses. The average runoff and soil losses from all crops grown in two complete rotations was much less than that from continuous cotton. The saving of soil may be attributed chiefly to the protection afforded by the wheat and lespedeza crops during the time they occupied the land, and to the residual effect of the lespedeza when followed by cotton. The decrease in runoff for the rotation system may be attributed primarily to the low rate of runoff from the lespedeza.

As much soil was lost when corn in the rotation, followed cotton without a winter cover crop, as when a continuous-cotton was used. The

data on crop-rotation experiments, here presented, show the beneficial effects of crop cover and organic residues resulting from the use of a rotation on land devoted to row crops.

The effectiveness of woods cover is materially reduced by burning the surface litter. The soil and water losses from plot A, the undisturbed virgin woods plot, and plot B, which is similar to plot A in all respects except that the surface litter was burned semiannually, are compared in table 13. The soil losses and runoff from the unburned woods has remained at extremely low values, consistently throughout the years of record, but there has been a progressive increase in the annual soil loss from the burned woods which reached a maximum of 7.81 tons of soil per acre in 1938 and 21.2 percent runoff in 1939. These latter losses are of important magnitude and represent but little improvement over the protection secured by good crop rotations. Appendix table 29 gives an annual summary of the rainfall, runoff, and soil losses for each individual plot of the control series from which it is possible to follow through the effects of the various cropping practices and soil conditions.

Table 13.—*Soil loss and runoff from undisturbed virgin woods as compared with virgin woods on which surface litter was burned semiannually, 1932-40*

Year	Rainfall	Unburned plot A			Burned plot B		
		Runoff		Soil loss per acre	Runoff		Soil loss per acre
	Inches	*Inches*	*Percent*	*Tons*	*Inches*	*Percent*	*Tons*
1932	55.28	0.11	0.2	0.001	0.16	0.3	0.01
1933	34.70	.07	.2	.001	.12	.4	.03
1934	49.34	.04	.1	.001	1.54	3.1	1.04
1935	42.80	.002	.01	.001	4.64	10.8	1.45
1936	60.00	.003	.01	.001	8.30	13.8	3.90
1937	47.52	.01	.02	.001	8.60	18.1	3.97
1938	47.76	.001	.01	.001	9.90	20.7	7.81
1939	42.34	.001	.01	.001	8.98	21.2	6.30
1940	38.45	.001	.01	.001	6.22	16.2	3.21
Average	46.47	.03	.06	.001	5.38	11.5	3.08

The losses from land of precisely the same kind devoted continuously to cotton were 31.2 tons of soil per acre and 12.4 percent of the rainfall as compared with 0.002 tons per acre of soil and 0.06 percent of the rainfall as runoff from the unburned hardwood forest area. As computed on the basis of these measurements, the land in continuous cotton lost 15,000 times more soil and 206 times more water as runoff than did the forested area.

Residual effects of cropping systems on soil and water losses.—At the end of 1938 the series of treatments on plots 1-12 making up the control plot experiment were discontinued. In order to determine the residual effect of these practices the 12 plots were planted to cotton for the 2 years, 1939 and 1940. All plots received an annual application of 600 pounds of a 4-10-4 fertilizer for the 2-year period, but no winter cover was used preceding either crop. Soil loss, runoff, and cotton yields for

Table 14.—*Residual effect of cropping systems on runoff and soil loss*

Plot No.	Previous treatment	1939			1940			2-year average			Relative soil loss (continuous cotton, plot 10 = 100)	
		Runoff[1]	Soil loss per acre	Yield, seed cotton	Runoff	Soil loss per acre	Yield, seed cotton	Runoff	Soil loss per acre	Yield per plot	1931-38	1939-40
		Inches	*Tons*	*Pounds*	*Inches*	*Tons*	*Pounds*	*Inches*	*Tons*	*Pounds*	*Percent*	*Percent*
1	Continuous cotton, desurfaced	4.16	25.49	5.90	2.87	16.32	7.62	3.51	20.90	6.76	103.2	134.5
2	Cotton-corn, desurfaced	4.87	21.61	12.81	3.50	22.93	9.88	4.18	22.27	11.34	57.5	131.2
3	Cotton-corn, desurfaced	3.99	20.67	12.37	2.93	16.04	10.66	3.46	18.36	11.52		
4	Bare	2.84	8.55	7.63	2.31	10.51	8.78	2.58	9.53	8.20	212.0	64.7
5	Cotton-corn-wheat-lespedeza rotation	5.26	26.19	15.12	3.68	22.93	12.72	4.47	24.56	13.92	....	....
6	Do	4.74	11.22	15.13	3.06	13.95	16.15	3.90	12.58	15.64	....	....
7	Do	3.53	9.59	15.50	3.19	13.90	14.15	3.36	11.74	14.82	....	....
8	Do	3.69	13.10	16.75	3.38	15.67	13.34	3.54	14.38	15.04	....	....
	Rotation averages, plots 5, 6, 7, and 8	....	....	....	....	....	....	3.82	15.56	14.86	46.1	105.7
9	Permanent sod	.09	.04	20.31	1.72	7.64	15.81	.90	3.84	18.06	1.0	26.1
10	Continuous cotton, standard plot	4.75	16.59	14.75	3.23	12.84	13.75	3.99	14.72	14.25	100.0	100.0
11	Continuous cotton, long plot	4.30	18.07	14.70	2.89	17.32	15.78	3.60	17.70	14.24	112.1	120.2
12	Continuous cotton, short plot	4.76	16.63	13.12	3.26	12.95	17.74	4.01	14.79	15.43	94.5	100.5

[1] Rainfall was 36.47 inches in 1939 and 31.09 inches in 1940.

each plot were determined and are reported in table 14. The striking feature of these data is the very low runoff and soil loss for plot 9 that had been covered with a permanent sod during the period prior to 1938. The first year's loss from this plot was very slight and the second year's loss was decidedly less than from any other plot. The value of sod protection was discussed in connection with the original experiment. The data here presented show further its value when followed by row crops.

From an analysis of the data recorded in table 14 it is apparent that the continuous grass cover (on plot 9) has been effective not only in reducing current soil and water losses during the continuance of the grass cover practice, but also during the 2-year period immediately following the termination of this practice. Comparing the results obtained during the 2-year post-test period with the 8-year period during which the cropping practices and rotations were studied, it was found that the beneficial effect of the sod has persisted but that benefits of the rotation of cotton-corn-wheat lespedeza did not persist when the rotation was discontinued and the plots were planted to continuous cotton. In order to have a direct comparison between the losses from the several plots during the experimental period with those from the same plots during the two seasons immediately following the termination of the studies, table 15 has been prepared.

Table 15.—*Soil losses during the 9-year test period, 1931-39, as compared with losses from the same plots for the 2-year period immediately following when all plots were devoted to continuous cotton.*

Plot No.	Cropping system 1931-39	Relative soil losses (continuous cotton, plot 10 = 100)	
		1931-39	1940-41
		Percent	*Percent*
10	Continuous cotton	100	100
1	Continuous cotton, desurfaced	103	134
2, 3	Cotton-corn, desurfaced	58	131
4	Bare hard fallow	212	65
5, 6, 7, 8	Rotation, cotton-corn-wheat-lespedeza	46	106
9	Permanent sod	1	26
11	Continuous cotton (virgin soil)	112	120
12	Continuous cotton (short plot)	94	100

The average soil and water losses and yield from plots 5 to 8 on which a 2-year period of cotton followed the 4-year rotation, as shown in table 15, are virtually the same as the soil and water losses and yield from plot 10, on which cotton had been grown continuously. This indicates that the benefits of the rotation did not carry over sufficiently to permit a continuous cropping system. Likewise on the artificially-eroded plots 1, 2, and 3, no beneficial effects of the 2-year rotation were carried over as the soil loss and runoff were about the same as from the continuous cotton practice followed on plot 1. Losses from plots 10, 11, and 12, which made up the slope length study, follow closely those of the initial experiment. The double length plot gave the highest soil loss but the lowest runoff.

Cotton-Organic Matter Plots

A series of twelve 1/100-acre plots was established during the summer of 1933 in M-field just south of the control plots on Cecil sandy clay loam, having a 10-percent slope. Two of these plots remained uncropped but were treated with an annual application of a 24-ton mulch of woods litter. The other 10 were planted to continuous cotton. Eight of the 10 received annual application of various kinds and amounts of organic material as soil amendment as early in January of the crop year as weather conditions would permit. Commercial fertilizer was not used on any of the plots during the experimental period.

At the time these plots were established in 1933, they were divided into two groups and equipped with two types of runoff catchment devices. Plots 1-6 were equipped with "Yarnell" 6-inch wasting and 1-inch sampling divisors. Plots 7-12 were equipped with "Uhland", Venturi flume divisors. These two types of equipment were replaced on 10 of the plots with Geib multi-slot divisors in the summer of 1937. Total catchment equipment was installed on the two mulched but uncropped plots in the spring of 1937. Records of crop yield and erosion losses were kept throughout the experimental period. Data on soil loss and runoff for the first 3 years are not presented here since this period was devoted primarily to testing the two types of divisors and to the establishment of procedure and technique in handling the runoff material. However, for the entire experimental period, 1933-40, the data show the same trend and the same relative order of magnitude as that reported for the shorter period.

The amount and kind of organic materials applied, with the resulting data on runoff, soil loss, and cotton yields are given in table 16.

The woods litter used on plots 1, 2, 11, and 12 was collected annually from nearby wooded areas immediately preceding the date of application. The pine needles were collected from areas having stand composed principally of pine and the hardwood litter from areas having a forest cover principally of oak. The materials used on plots 4, 6, 7, 8,

Table 16.—*Average annual runoff and soil losses and crop yields from the cotton organic-matter plots,*[1] *1933-40*[2]

Plot No.	Treatment		Runoff		Soil loss per acre	Yield of seed cotton per acre
	Material	Amount per acre	Amount	Percent of precipitation[3]		
		Tons	*Inches*	*Percent*	*Tons*	*Pounds*
1	Pine-needle mulch	24	0.27	0.62	0.01	....
2	Hardwood-litter mulch	24	.05	.11	.005	....
3	None	....	6.51	14.86	36.18	591
4	Compost	60	.54	1.23	.86	2,631
5	Stable manure	8	2.57	5.86	6.63	1,887
6	Compost	12	3.87	8.83	13.91	1,793
7	Do	12	3.89	8.88	12.55	1,889
8	Do	18	2.24	5.11	4.67	1,444
9	Do	18	1.65	3.77	4.19	1,901
10	None	....	7.54	17.21	31.93	636
11	Hardwood litter spaded	24	1.40	3.19	3.11	1,501
12	Pine needles spaded	24	1.53	3.49	3.36	1,395

[1]Plots 4-12 were spaded in about 6 inches and treatments repeated annually.

[2]Soil losses and runoff for the period Sept. 1, 1937, to Nov. 30, 1940. The period of record for yields only is 1933-40.

[3]Average annual precipitation for the period 43.82 inches.

Table 17.—*Composition of compost heap*

Layer No. from bottom of heap	Depth of layer	Material	Composition by volume
	Inches		*Percent*
1	10	Woods litter	14.29
2	2	Stable manure	2.86
3	18	Woods litter	25.71
4	2	Green cotton seed	2.86
5	18	Woods litter	25.71
6	2	Stable manure	2.86
7	18	Woods litter	25.71

and 9 were composted in the early spring prior to being applied to the plots the following January. The kind and relative amounts of material used in the compost heap are shown in table 17.

In a report (*1*) on this experiment, published in 1939, attention was called to the effect of a vegetative mulch in conserving soil and rainfall. For a period of 3 years this earlier report shows that one tract of land covered with a 2-inch layer of undecomposed pine needles and another tract with hardwood forest litter, lost on an average only 0.17 ton of soil per acre annually and 8.6 percent of the total rainfall as runoff. During this same period a nearby area of the same soil and slope, cleared at the same time, but cultivated continuously to cotton, lost 32.26 tons of soil per acre and 16.13 percent of the total rainfall. The final results tabulated in table 16 covering the results to November 1940 are in harmony with the results shown in the previous record which were for the period 1937-40.

The results of these studies may be summarized as follows:

Runoff and soil losses decreased and cotton yields increased rather sharply when organic matter was applied in the quantities used in this experiment.

The application of 8 tons of stable manure was slightly more effective than either 12 or 24 tons of woods litter in increasing cotton yields, and more effective than 12 tons of compost in reducing soil losses and runoff.

The 60-ton rate of application of compost, while not practically feasible, resulted in a very high cotton yield and reduced the soil loss to less than 3 percent of the amount lost by the untreated plots.

Field and Watershed Studies

Runoff and soil losses were measured from an unterraced, cultivated watershed (C-8) and from a watershed with a mixed stand of pine and hardwood timber. The cultivated watershed contained 5⅛ acres and was on Cecil soil with an average land slope of 7.2 percent. The wooded watershed had an area of 6 acres and was on Appling soil with an average slope of 18.6 percent. The soil and water losses from each watershed by years and the crop yields for crops grown on the cultivated area, are recorded in table 18. The total and average losses of the two watersheds are given for the 6-year period 1933-38. Because of the wide variation in the several characteristics of the two areas, however, no attempt has been made to compare their behavior except to call attention to the fact that the cultivated area retained more of the rainfall than did the

Table 18.—*Record of runoff and soil losses from a cultivated and a wood watershed. January 1, 1933, to June 19, 1938*

Type of treatment	Year	Rainfall	Runoff		Soil loss per acre
			Amount	Percent of rainfall	
		Inches	*Inches*	*Percent*	*Tons*
Cultivated:					
Watershed C-8:					
Mixed Cecil clay loam and sandy loam Land slope 7.2 percent Drainage area 5.12 acres	1933	34.78	8.42	24.2	16.7
	1934	50.84	1.44	2.8	.7
	1935	46.27	6.61	14.4	31.2
	1936	63.15	5.45	8.6	6.6
	1937	51.15	5.47	10.7	2.0
	1938[1]	19.84	0.20	1.0	(2)
	Total	266.03	27.62	....	57.2
Wooded:					
Watershed W-23:					
Appling sandy loam Land slope 18.6 percent Drainage area 6.0 acres	1933	34.78	1.58	4.5	1.076
	1934	50.84	5.88	11.1	.096
	1935	46.27	3.92	8.5	.026
	1936	63.15	10.98	16.8	.155
	1937	51.15	7.34	17.6	.057
	1938[1]	19.84	0 55	12.9	.009
	Total	266.03	30.25	....	.319

[1]January 1 to June 19.
[2]Trace.

wooded plot, whereas the forest litter offered almost complete protection against soil losses. Figure 12 shows the character of the leaf litter which covered the watershed, also the timber stand. The wooded watershed lost but little soil during the period of measurement, although the average slope was 18.6 percent. The soil losses from the cultivated watershed with only 7 percent slope averaged 11.58 tons per acre, for the 6-year period, 85 percent of this loss occurring during two seasons—in 1933 when the land was in oats, and in 1935, when cotton was the crop. The high soil loss from oats in 1933 was due in the main to excessive rainfall in March of that year.

On the cultivated watershed lespedeza reduced the soil loss to 0.68 ton per acre in 1934. But the cotton in 1935 showed a loss of more than 31 tons of soil per acre. This loss was accentuated by excessive rainfall (7.75 inches) coming in several large storms following each other in March, shortly after the lespedeza was turned under. Lespedeza permitted but 2.66 tons per acre or 4 percent of the total soil loss, although it occupied the land 3 out of the 6 years of record. In 1938 the soil loss under lespedeza was 0.03 ton per acre, which compares very favorably with even the lowest annual loss from the wooded watershed and is lower than the 7-year average of 0.09 ton per acre from that area.

The runoff, as percent of total rainfall, from the cultivated watershed, average 10.4 percent and from the wooded watershed, 12.6 percent. Runoff was highest under oats in 1933, reaching 25.3 percent, and lowest under lespedeza in 1938, when it was but 1.2 percent of the

annual rainfall. The maximum of runoff from the cultivated watershed when in a cover crop was 4.63 inches per hour, and when in a cultivated crop 3.61 inches per hour. The maximum rate from the wooded watershed was 0.06 inches per hour. The greater total average water loss from the wooded watershed was not the result, therefore, of a rapid flash runoff, but was due to the fact that runoff occurred from this watershed for long continuous periods of time following heavy rains. The open, pervious nature of the Appling topsoil, the tight high clay content subsoil, and the 18.6-percent average slope of the land combined to make a condition of subsurface drainage to the bottom of the watershed that was quite similar to a wet-weather spring flow. Low rates of flow were recorded as much as 2 weeks or more after the cessation of winter rains of long duration and low intensity. Records from virgin woods plots on Cecil soil with lesser grades at other locations on the station showed even lower rates of runoff (table 10).

Lysimeter Studies

Late in 1934 the station was equipped with two batteries of three lysimeters each, patterned after the installation at the Clarinda, Iowa station. The method of constructing these special lysimeters and the technique employed in their installation has been described by Musgrave (*6*). The lysimeters, which enclose a 3-foot profile, were located on sandy clay loam directly south of the control plots. The installation was such as to leave the soil in its natural condition so far as possible. The individual units in the two series included in this experiment were identical in construction but differed in the cropping system followed. Lysimeters 1, 3, and 5 were cropped to corn each year, followed after the first year by a winter cover crop of rye and vetch; while lysimeters 2, 4, and 6 were also in corn after the second year but remained fallow during the winter season (table 19).

Measurements of the percolate were made at frequent intervals and the runoff was determined after each rain by a method similar to that employed for the neighboring control plots. The fallow units were cultivated and handled in the same manner as those planted to corn, with the exception that weed seedlings following the last cultivation were removed by pulling or hoeing as soon as they made their appearance. The detailed data of monthly rainfall, surface runoff, percolate, and calculated evapotranspiration from the lysimeters are given in table 20 and shown graphically in figure 17. The evapotranspiration, or vapor losses, were calculated by subtracting the sum of the measured runoff

Table 19.—*Cropping systems for lysimeters (Cecil sandy clay loam) 3-foot profile*

Year	Lysimeters 1, 3, and 5		Lysimeters 2, 4, and 6	
	Summer	Winter	Summer	Winter
1935	Corn	Fallow (spaded)	Kobe lespedeza	Kobe lespedeza stubble
1936	Do	Rye and vetch	Fallow (spaded)	Fallow (spaded)
1937	Do	do	Corn	Do
1938	Do	do	do	Do
1939	Do	do	do	Do

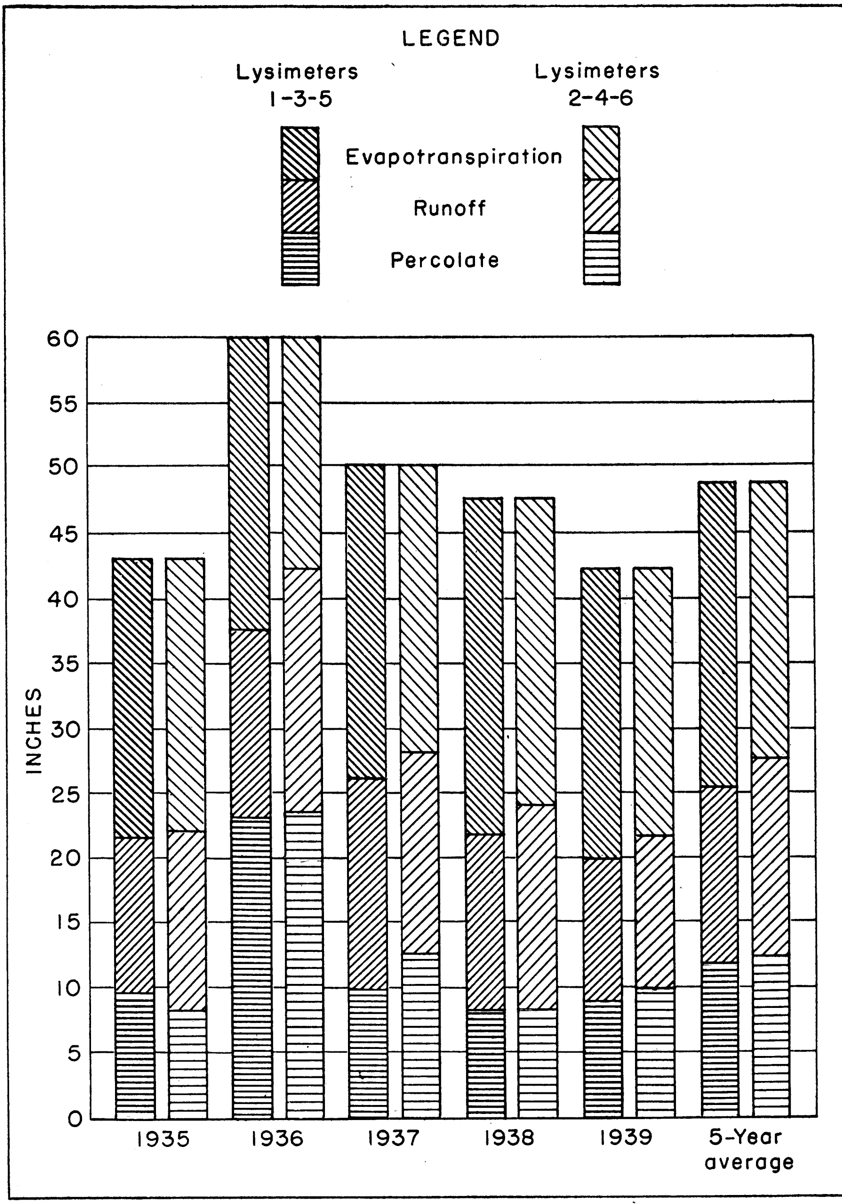


Figure 17.—Rainfall percolate and evapotranspiration.

and percolation losses from the total rainfall. The annual averages and totals for the 5-year period also are shown in table 21.

The date for the entire period are further summarized in table 22. This table shows that, for the conditions under which the experiment was conducted, the presence of a winter cover caused little difference

Table 20.—*Monthly surface runoff, percolate, and calculated evapotranspiration for lysimeters enclosing 3-foot profiles of Cecil sandy clay loam for the 5-year period 1935-39*

Month	Rainfall		Lysimeters 1, 3, and 5, winter cover crop						Lysimeters 2, 4, and 6, winter fallow					
			Runoff		Percolate		Evapotranspiration		Runoff		Percolate		Evapotranspiration	
	Monthly total	Monthly average	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January	28.07	5.61	7.05	1.41	15.85	3.17	5.17	1.03	6.58	1.32	15.94	3.19	5.55	1.11
February	20.55	4.11	3.00	.60	11.87	2.37	5.68	1.14	2.42	.48	12.71	2.54	5.42	1.08
March	23.09	4.62	5.11	1.02	12.12	2.42	5.86	1.17	5.86	1.17	12.08	2.42	5.15	1.03
April	19.14	3.83	4.44	.89	4.60	.92	10.10	2.02	5.31	1.06	6.08	1.22	7.75	1.55
May	12.00	2.40	1.45	.29	1.31	.26	9.24	1.85	1.87	.37	1.31	.26	8.82	1.76
June	20.02	4.00	7.01	1.40	1.21	.24	11.80	2.36	7.92	1.58	.98	.20	11.12	2.22
July	35.07	7.01	13.92	2.78	2.11	.42	19.04	3.81	17.15	3.43	1.89	.38	16.03	3.19
August	23.42	4.68	10.46	2.09	1.43	.29	11.53	2.31	11.91	2.38	1.08	.22	10.43	2.09
September	11.40	2.28	2.85	.57	.05	.01	8.50	1.70	2.82	.56	.04	.01	8.54	1.71
October	18.40	3.68	5.78	1.16	2.41	.48	10.21	2.04	6.94	1.39	3.03	.61	8.43	1.69
November	14.26	2.85	4.11	.82	.75	.15	9.40	1.88	5.10	1.02	.76	.15	8.40	1.68
December	16.94	3.40	1.99	.40	5.69	1.14	9.26	1.85	1.73	.35	6.00	1.20	9.21	1.84
Total	242.36	48.47	67.17	13.43	59.40	11.87	115.79	23.16	75.61	15.11	61.90	12.40	104.85	20.95
Average	20.20	4.04	5.60	1.12	4.95	0.99	9.65	1.93	6.30	1.26	5.16	1.03	8.73	1.75

Table 21.—*Average annual rainfall, surface runoff, percolate, and calculated evapotranspiration from lysimeters of Cecil sandy clay loam, 10-percent slope, 1935-39*

Year	Rainfall	Average surface runoff				Average percolate				Average evapotranspiration			
		Lysimeters 1, 3, and 5		Lysimeters 2, 4, and 6		Lysimeters 1, 3, and 5		Lysimeters 2, 4, and 6		Lysimeters 1, 3, and 5		Lysimeters 2, 4, and 6	
	Inches	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*	*Inches*	*Percent*
1935	42.80	11.90	27.80	13.85	32.36	9.70	22.66	8.02	18.74	21.20	49.53	20.93	48.90
1936	60.00	14.59	24.32	18.73	31.22	22.92	38.20	23.43	39.05	22.49	37.48	17.84	29.73
1937	50.00	15.98	31.98	15.53	31.06	9.91	19.82	12.41	24.82	24.11	48.22	22.06	44.12
1938	47.45	13.62	28.70	15.78	33.26	8.16	17.20	8.16	17.20	25.67	54.10	23.51	49.55
1939	42.11	11.08	26.31	11.70	27.78	8.71	20.68	9.88	23.46	22.32	53.00	20.53	48.75
5-year total	242.36	67.17	....	75.59	....	59.40	....	61.90	....	115.79	....	104.87	....
5-year average	48.47	13.43	27.71	15.12	31.19	11.88	24.51	12.38	25.54	23.16	47.78	20.97	43.26

in the distribution of the losses from rainfall, percolate, and evapotranspiration. There is, however, a slightly higher runoff recorded for the winter fallow than from the winter cover crop conditions, with pactically no difference in the average percolation losses. The slightly lower runoff losses from the soil protected by the winter covers is reflected in the higher evapotranspiration losses recorded for lysimeters of the 1, 3, 5 series. A graphic representation of the average losses by years is shown in figure 18.

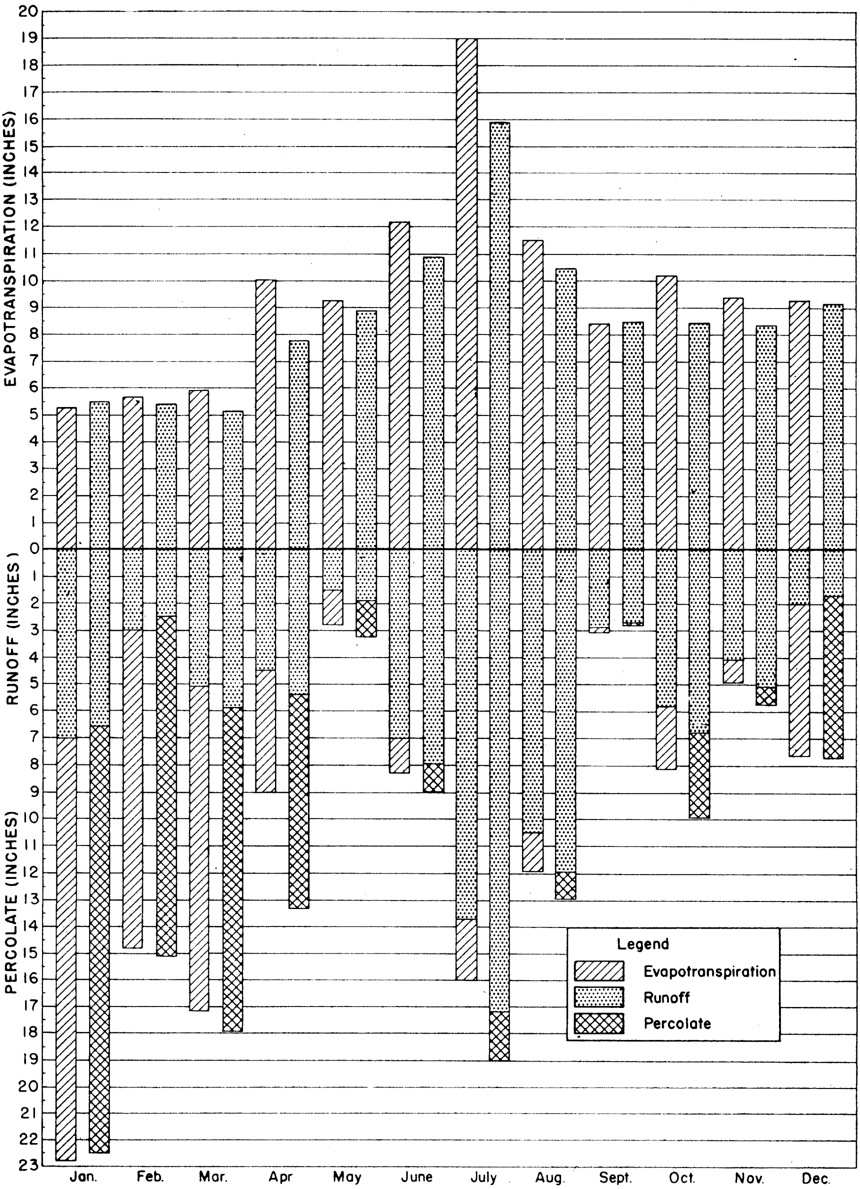


Figure 18.—Annual runoff, percolation, and evapotranspiration losses from lysimeters.

Table 22.—*Five-year average lysimeter losses, 1935-39*
[Total rainfall for period 242.36 inches]

Losses from	Lysimeters 1, 3, and 5 winter cover		Lysimeters 2, 4, and 6 winter fallow	
	Inches	*Percent*	*Inches*	*Percent*
Runoff	67.17	27.7	75.61	31.2
Percolate	59.40	24.5	61.90	25.6
Evapotranspiration	115.79	47.8	104.75	43.2

Terrace Studies

Unterraced areas are measured as closed watersheds; that is, there is no way for eroded material carried to the lower parts of the areas to escape except through the measuring devices. Drainage areas are formed by terrace ridges. The interterrace areas, however, are not entirely closed, and a considerable portion of the soil eroded from the upper parts of the interterrace areas is deposited in the terrace channels and does not pass on with the runoff through the measuring devices at the outlet ends of the terrace channels. Under some systems of terrace maintenance part of the soil deposited in the channels is periodically moved up and over the terrace ridges. From the lower sides of the ridges this is eventually eroded into the next terrace channel down slope. Over a long period this cycle of erosion, deposition, and transposition through cultural operations, usually is repeated many times. As a result there is continuing down-slope movement of soil taking place, varying in amount from an insignificant minimum on gently sloping soils of favorable porosity, to a serious maximum on steep, highly erodible soils of low absorptive capacity. Obviously, this interterrace movement of soil is not measured by the devices placed at the ends of the terrace channels. The magnitude of the downhill shift occasioned by the transverse movement of soil over terrace ridges is difficult to determine but has been studied by means of profile elevation measurements at 3- and 5-year intervals.

Through the adoption of a maintenance system in which the soil deposited in terrace channels is moved up slope each time the land is plowed, the movement of soil across terrace intervals by erosion may be greatly reduced and, of course, good rotation, the use of seasonal cover crops, strip cropping, and other good soil management practices still further reduces the losses.

The terraces employed on the different fields of the Statesville Experiment Station were all of the broad-base type but differed in length, vertical interval, and channel grade. The land slope of these fields varied from a minimum of about 6 to 8 percent on field E to a maximum of almost 17 percent on field A. The soils ranged in texture from sandy loam to heavy clay loam. The characteristics of the individual terraces are shown in table 23 together with the average runoff and soil losses recorded for the period of experimentation. Because of several variables

Table 23.—*Average annual runoff and soil loss, from all terraces as measured at the terrace outlets*[1]

Terrace No.	Terrace characteristics			Rainfall	Runoff		Soil loss per acre
	Channel grade	Vertical interval	Length		Amount	Percent of rainfall	
	Inches	*Feet*	*Feet*	*Inches*	*Inches*	*Percent*	*Tons*
A-3	Level	4	508	46.93	8.03	17.1	6.08
A-4	Do	5	558	46.93	10.73	22.9	4.65
B-2[2]	1–6	6	1,500	46.34	6.69	14.4	1.77
B-3[2]	1–6	4	1,500	46.34	5.28	11.4	1.09
B-4	3	4	1,200	46.34	4.28	9.2	.69
B-5	6	4	1,200	46.34	6.99	15.1	1.80
C-5	3	4	1,400	47.60	9.84	20.6	3.91
C-6	3	4	1,700	47.60	13.72	28.8	2.76
C-7	3	4	2,000	47.60	13.34	28.0	2.60
D-2	9	5	665	48.06	13.13	27.3	5.95
D-3	6	5	655	48.06	11.84	24.6	6.11
D-4[3]	0–6	5	685	48.06	13.01	27.1	5.15
D-5	2	5	735	48.06	11.34	23.6	4.87
D-6	Level	5	655	48.06	7.87	16.4	2.10
E-2	3	3	700	46.34	7.04	15.2	2.38
E-3	3	5	700	46.34	6.36	13.7	2.34
E-4	3	7	700	46.34	5.84	12.6	2.77
E-9[4]	3	9	700	52.55	12.46	23.7	6.78
F-3	3	2	550	48.70	14.90	30.6	4.15
F-4	3	6	550	48.70	13.60	27.9	4.15
F-5	3	4	550	48.70	12.27	25.2	2.35

[1]The period of record for A terraces was from June 17, 1932, to Dec. 31, 1936; for F terraces from June 17, 1932, to June 30, 1938; for B, D, and E terraces from September 1, 1931, to June 30, 1938, and for C terraces from Jan. 1, 1933, to June 19, 1938.

[2]Terraces B-2 and B-3 had variable grades of 1 inch per 100 feet for 300 feet; 2 inches per 100 feet for 300 feet; 3 inches per 100 feet for 300 feet; 4 inches per 100 feet for 300 feet, and 6 inches per 100 feet for 300 feet.

[3]Terrace D-4 had a variable grade of level for 250 feet; 4 inches per 100 feet for 200 feet; 6 inches per 100 feet for 200 feet.

[4]Period of record 2½ years.

it is necessary to select for comparison only those terraces that differ in a single characteristic. For example, a comparison of the effect of length is possible only between the terraces of different lengths but having the same vertical interval and channel grade. It is necessary, also, that the terraces be located in the same field with land that is fairly uniform in slope and upon which the same cropping system is practiced.

Terrace Length

For field C, with a land slope of 9 to 10 percent and on Cecil sandy loam soil, terraces C-5, C-6 and C-7 may be compared with respect to length, since each had the same channel grade and vertical interval spacing. Table 24 shows that the terraces had a channel grade of 3 inches per 100 feet and a vertical interval of 4 feet but varied in length from 1,400 feet to 2,000 feet. The shortest terrace, C-5, with a length of 1,400 feet, lost one-third less water and a half more soil per acre than the longer terraces, but the 1,700-foot and the 2,000-foot terraces suffered practically the same runoff and soil losses. The 1,200-foot terrace B-4, of Field B, on practically the same land slope and with the same channel grade and vertical interval as those on Field C, had lesser losses than the longer terraces of Field C. This may be accounted for by the fact that the cropping systems for the two fields, E and B, are not precisely comparable. There is a possibility that the differences in cropping are sufficient to invalidate any direct comparison between these otherwise comparable terraces.

Table 24.—*Average runoff and soil loss per acre as measured at the ends of terraces of different lengths for the 8-year period 1931-38*

Terrace No.	Terrace characteristics			Losses per acre	
	Channel grade	Vertical interval	Length	Runoff	Soil
	Inches	*Feet*	*Feet*	*Inches*	*Tons*
C-5	3	4	1,400	9.82	3.93
C-6	3	4	1,700	12.10	2.61
C-7	3	4	2,000	11.98	2.59
B-3	3	4	1,200	4.28	.69

Channel Grade

Two pairs of terraces are available for comparison of the effect of terrace channel grade on soil and water losses, Terraces B-4 and B-5 are each 665 feet long with 5-foot vertical interval but differing channel grade (table 25). Terrace B-5, with a constant channel grade of 6 inches per 100 feet lost slightly less water and practically the same amount of soil per acre as did the companion terrace B-4 with a channel grade of 9 inches per 100 feet. Terraces D-2 and D-3 were each 1,200 feet long and situated on a slightly steeper land slope. Terrace D-3 with a channel grade of 6 inches per 100 feet lost about 63 percent more water and almost 3 times as much soil per acre as terrace D-2 with a channel grade of 3 inches. From these data it would appear that for soils of this character with a land slope of from 8 to 13 percent, a channel grade somewhere between 3 and 6 inches per 100 feet will give satisfactory performance. Observations lead to the conclusion that channels with grades steeper than 6 inches are inclined to scour and that grades below 3 inches encourage delta deposits in the channel, which may result in ponding of water or even the overtopping of the terrace ridges, during rains of high intensities.

Table 25.—*Average runoff and soil loss per acre as measured at the ends of terraces of different channel grade for the 8-year period 1931-38*

[Land slope, 8 to 13 percent]

Terrace No.	Terrace characteristics			Losses per acre	
	Channel grade	Length	Vertical interval	Runoff	Soil
	Inches	*Feet*	*Feet*	*Inches*	*Tons*
B-4	9	665	5	13.13	5.95
B-5	6	665	5	11.81	6.11
D-2	3	1,200	4	4.28	.69
D-3	6	1,200	4	6.99	1.80

Terrace Interval

Three terraces in field F were available for a comparison of the effect of vertical interval on soil and water losses (table 26). Likewise in field E there were 3 terraces of the same channel grade and length but differing in vertical interval. Field B had 2 terraces of the same channel grade and length but differing from each other in vertical interval,

and from those of fields F and E in that terraces B-2 and B-3 had variable graded channels. This prevents direct comparison between the terraces of field B and those of fields F and E. Field F terrace F-5, with 4-foot vertical interval shows substantially less soil and water losses than either terrace F-3 with 2-foot vertical interval or terrace F-4 with a 6-foot interval, the soil losses being almost twice as great from the 2-foot and the 6-foot intervals as from the intermediate 4-foot interval. The intermediate interval shows less water lost as runoff than from the narrower or the wider intervals, but the difference is not so great as that of soil losses.

Table 26.—*Average runoff and soil loss per acre as measured at the ends of terraces of different vertical spacings for the 8-year period 1931-38*
[Land slope, 7 to 11 percent]

Terrace No.	Terrace characteristics			Losses per acre	
	Channel grade	Length	Vertical interval	Runoff	Soil
	Inches	*Feet*	*Feet*	*Inches*	*Tons*
E-2	3	700	3	7.04	2.38
E-3	3	700	5	6.36	2.34
E-4	3	700	7	5.84	2.77
E-9	3	700	9	12.46	6.78
F-3	3	550	2	14.90	4.15
F-5	3	550	4	12.27	2.35
F-4	3	550	6	13.60	4.15
B-2	1-6	1,500	6	6.69	1.77
B-3	1-6	1,500	4	5.28	1.09

The terraces of field E, being of the same channel grade and length are directly comparable as to vertical interval. For this set of terraces the runoff water loss is slightly less for the 7-foot interval than for those with lesser intervals. The soil loss is slightly greater for the wide interval with little difference in the wash-off from the 3- and the 5-foot intervals. For terrace E-9, however, with a vertical interval of 9-feet, soil and water losses were practically twice as great as from those with lesser intervals. For field F with the terraces 550 feet long and all with 3-inch channel grade both the runoff and soil losses were higher for the 2- and the 6-foot intervals than for the intermediate 4-foot interval. Field B, with 1,500-foot terraces, suffered higher losses of both soil and water from terrace B-2 with the 6-foot interval than from terrace B-3 with a 4-foot vertical interval. From these data and from field observations it is concluded that the larger losses from the terrace with the smallest vertical interval resulted in part at least from the steepening of the land slope on the back side of the terrace ridge in the process of terrace construction.

Profile of Terrace Interval

The down-slope movements, or shifting of soil in the inter-terraced areas in fields A and B is shown graphically in figures 19 and 20. The levels were run in A-field in the spring of 1934 and again in the spring of 1939, after an interval of 5 years. They were run in B-field in the spring of 1934 and again in the summer of 1937, after a time interval of 3 years. Each field had only one clean-tilled crop during the interval between the first and last profile measurements.

Figure 19 shows that there has been a decided shift of the soil down the slope in all terraces in the A-field as indicated by the increased area of the ridge. Considerable soil has been removed from the inter-

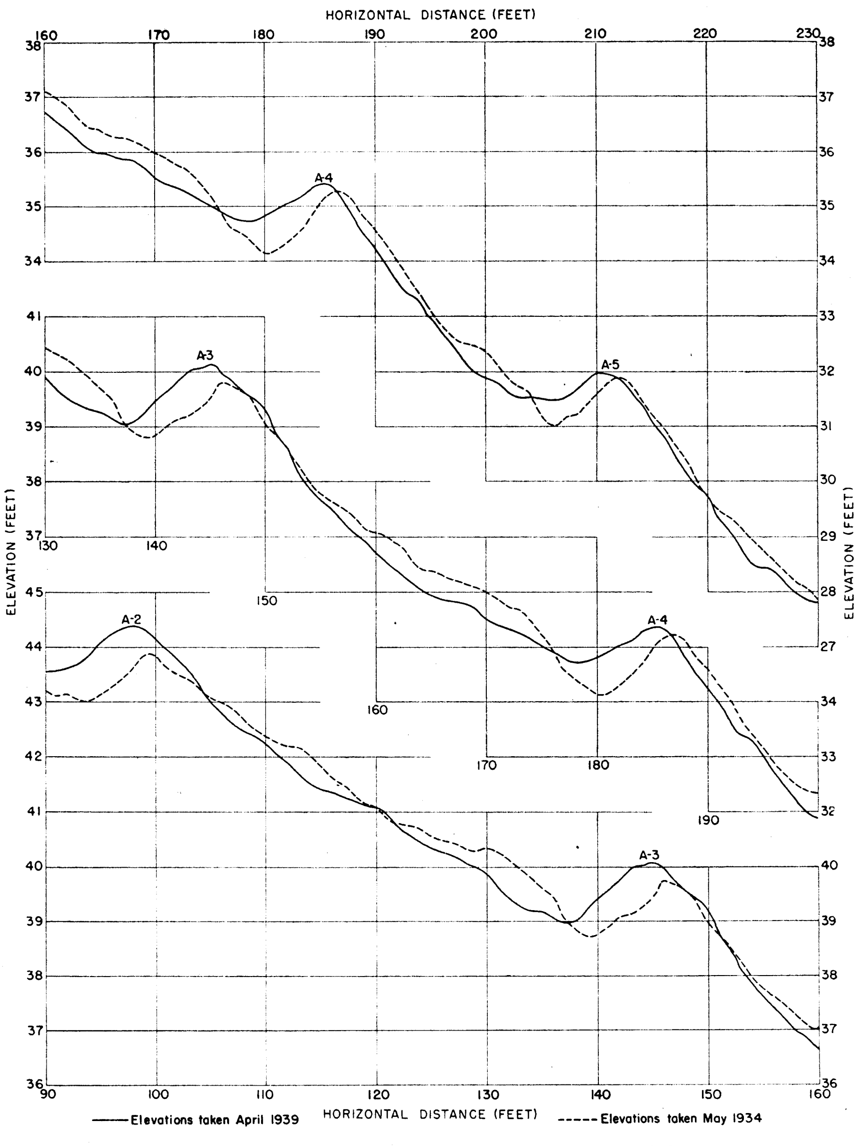


Figure 19.—Shifting of soil in interterraced area field A.

terrace areas of the different terraces. The general tendency is to level off the surface soil, forming a smooth profile from the terrace crest to the lower channel. Figure 20 shows that there is little or no tendency for the soil in B-field to shift down the slope. The general trend is to smooth out the profile and produce a straight line from the crest of the terrace to the flow line of the channel below. The difference in the

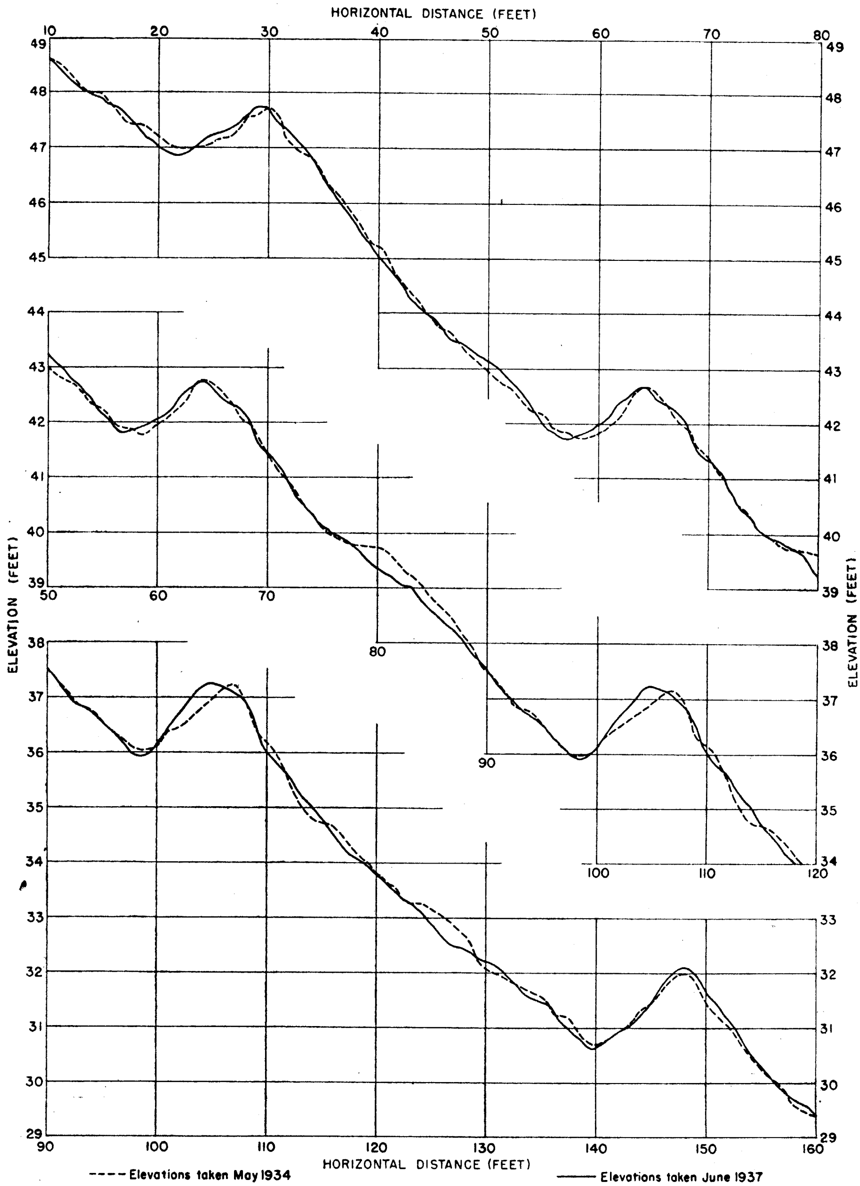


Figure 20.—Shifting of soil in interterraced area field B.

behavior of these terraces may be explained by the fact that the A-terraces were of level channel grade and that the B-terraces were of variable grade (1 to 6 inches) construction.

Terrace Outlet and Channel Structure

The stabilization of terrace outlets and outlet channels following the construction of the experimental terraces afforded an opportunity

to observe the relative efficiency of several types of stabilizing structures employed. These included vegetative outlets, loose rock in wire nets, field stone and cull brick set in cement mortar, bituminous paving, and concrete check walls. Records were kept on costs per unit and per linear foot of ditch for the mechanical type of control structures. More complete details describing these treatments and structures are given in a mimeographed 5-year progress report of the station for the years 1931-35.

The performance of these various types of mechanical structures was satisfactory. However, the practicability of their use must be determined by their cost. When labor was considered in the cost, the concrete check walls were found most economical per linear foot of channel.

Observations were made of the results of seeding and planting clover, alfalfa, rye, annual lespedeza, grass mixtures, and honeysuckle vines in terrace outlet channels. No Bermuda grass was planted because the farmers of the region object to the introduction of this grass. Of the plants tested, only the honeysuckle accorded much protection, its maximum effect being secured only after the plants became thoroughly established and were not disturbed by terrace-maintenance operations. It must be remembered, however, that the widespread use of various types of vegetation, in terrace outlets, channels, and in meadow strips during recent years, have definitely demonstrated their usefulness as a substitute for masonry structures for controlling runoff from small watersheds.

Gully Control

Check dams of loose rock, brush, sod bags, poles, logs, concrete, and brick, as well as a large earthen dam with a concrete drop inlet were constructed on the farm. Another large earthen dam with a side spillway was constructed on a nearby farm, under the supervision of the station staff. A check on the performance of these structures, and inspection of large numbers of similar structures on operations projects has led to the following conclusions in regard to the use of various structures, both temporary and permanent, for gully control:

All types of check dams, whether of brush or impervious material, require spillway notches large enough to care for maximum flows. If properly designed, so-called pervious dams soon become practically impervious through the accumulation of soil.

In the design and construction of check dams the foremost considerations are the size and characteristics of the watershed area. Upon these depend the selections of the type of structure as well as the details of construction.

A thorough bond between a structure and the earth into which it is built is essential. Drying, freezing, thawing, swelling, hydraulic pressure, and energy must not cause leakage under or around the ends of a structure. The structure should be watertight so that it will force flood flows through the notch and prevent all flow under the structure. against the banks of the gully, or through the structure.

A properly designed apron or other protective structure is necessary to prevent undercutting or eddying against the bottom and sides of a gully except for suspended net dams closely spaced on small watersheds.

Structures designed for temporary use should have a low drop, and

should be built to last long enough for the vegetation upon which permanent control is to depend to become well established.

Brush dams settled about 25 percent of their original height in from 1 to 3 years. The brush dams built at the Statesville station were in good condition after 3 years' service.

The rate of silting behind a dam varies with the condition of the contributing watershed and the number of dams above. When a dam is below a cultivated watershed, a few heavy rains usually fill the basin to capacity. The soil caught above the dams and the moisture conserved afford very favorable conditions for plant growth, and the establishment of protective vegetation.

Loose-rock dams give satisfactory service for watersheds of 2 acres or less. Some masonry work about the upper surface of a loose-rock dam aids in maintaining the spillway and in preventing displacement of the stones.

Temporary checks of straw held down by flexible poles attached to stakes midway of the poles, gave satisfactory and inexpensive protection during a single crop season. They were more satisfactory than sack dams filled with soil and grass seed, and the average cost was less than brush checks held by stakes and wire.

APPLICATION OF STATION DATA TO EROSION CONTROL IN THE CENTRAL PIEDMONT AREA

The same problem that arises in all research studies, namely that of projecting the data into recommendations for large scale use, must be dealt with in regard to the findings secured at the Statesville station. The seasonal aspect of erosional losses from cultivated land which is reflected by the station records, has shown that erosion control measures must be designed primarily to take care of summer rainfall. The records show that by far the greater portion of the total soil losses from cultivated land occur at this time. Fortunately this is the period when vegetative cover commonly is at its most effective stage and close-growing vegetative cover has proven to be practicable and extremely effective in protecting soil from erosion damage. However, this is also the period of intensive cultivation of row crops, and erosion may be accelerated by this factor.

The reduction in soil losses by use of a 4-year rotation with 2 years of row crops and 2 years of close-growing vegetation, were secured in the main, from the protection afforded during the years that small grain and lespedeza occupied the land. Some residual effect of the lespedeza was shown by the reduced loss from the cotton following lespedeza in the rotation, when compared to continuous cotton. Plots devoted to corn in the rotation that followed cotton without a winter cover crop, lost more soil than those planted to continuous cotton. However, on the desurfaced plots having a 2-year rotation of cotton and corn with a winter cover crop of rye and vetch following the cotton, corn lost less soil than the cotton. From the evidence it appears that the row crop following a cover crop will lose less soil than one that does not follow a winter cover crop.

The use of crop rotations containing legumes and a close growing or sod crop will materially reduce erosion. The effectiveness of the rotation will depend primarily upon the percent of sod crops or close-growing vegetation in the rotation during the summer months and

secondarily upon the amount of residual effect upon the row crop following the turning under of the protective cover. Although the 4-year rotation of cotton, corn, wheat and lespedeza, tested on the station, cut soil losses to less than one-half of that from continuous cotton, the rotation average annual soil loss of 14.4 tons per acre is still too high for adequate erosion control. Unless the percentage of close-growing crops is increased it is evident that some mechanical assistance in maintaining the soil in place must be used. The need for contour tillage and terracing is indicated for sloping land used for row crops.

Strip cropping.—From observations made on the strip-cropped fields on the station and on other fields throughout the area it is evident that the effectiveness of strip cropping for erosion control in the central Piedmont area is directly related to the quality and quantity of the cover in the strips of close-growing vegetation, and to the degree that runoff water, which may move laterally along the contour cultivation marks, can be prevented from concentrating in low spots, thus causing excessive erosion when it eventually breaks through at these points.

Small grains and lespedeza are most frequently used for the strips of erosion-resisting vegetation in this area. Small grain has not been satisfactory for this purpose, but lespedeza, if a good stand and of a vigorous growth, is secured, may serve satisfactorily under favorable topographical conditions. To designate lespedeza, or any other close-growing crop as a soil-conserving crop may be misleading. The ability of any crop to hold the soil on the field is directly related to the nature of the ground cover produced. Inadequate protection and heavy soil losses may occur from areas in so-called soil-conserving crops, if lack of fertility or other unfavorable conditions cause poor stands and weak growth of the plants. Strip cropping cannot be expected to afford adequate protection against soil losses on thin unproductive land unless reinforced by other conservation measures.

A dense growth of close-growing vegetation in the protective strip may cause most of the debris and silt carried by the runoff coming into it from the cultivated strips to be deposited, while the water flows on through the vegetative strip into the cultivated area below. It is essential that the excess water enter the protective strip in an even sheet flow and not as concentrated rill or gullyflow. Slopes having a concave aspect should not be strip cropped. This practice should be considered only on slopes of level to convex aspect. Fields that have numerous rills or shoe-string gullies too deep to erase by cultivation are not suitable for strip cropping, but an occasional small depression in an otherwise suitable field, need not constitute an unsurmountable barrier if the depressions are converted into well-grassed waterways.

The limits of degree and length of slopes that can be successfully strip cropped are difficult to assign, as they are dependent upon several interacting variables such as soil type, depth of topsoil, and cropping system used. However, it can be generally stated that the width of the cultivated strips should be decreased with increased degree of slope and in general should be somewhat less than interterrace spacing for the same slope, since surplus water is not conducted from the field at each terrace interval in strip cropping. Slope length should not exceed that which will require more than three cultivated strips. Longer slopes should be given additional protection by terraces or kept in permanent vegetation if terraces cannot be constructed economically.

Organic matter additions, surface litter.—Organic matter in quantities ranging from 8 to 60 tons per acre, incorporated into the soil in the form of barnyard manure or woods litter compost, increased cotton yields, and reduced soil losses and runoff to low quantities. The addition of woods litter at the rate of 24 tons per acre is also effective in controlling soil and water losses. If large quantities of organic matter are available, its use for controlling erosion and increasing yields is highly desirable. Contour tillage will reduce erosion losses, but contour tillage alone will not control erosion resulting from the typical summer thunderstorms commonly experienced in the central Piedmont area; hence this practice should be supported by other means such as terracing or the application of surface litter.

Terracing.—Sloping land in the central Piedmont area, devoted to growing row crops should be terraced for maximum protection from erosion. The extent of terracing on sloping land will be limited only by the economics of terrace construction and maintenance. Several types of terraces gave satisfactory results for the conditions under which they were tested at the station. Terraces with an average settled ridge height of 1.6 feet, and an average base of 24.7 feet, in lengths of 500 feet to 2,000 feet, and with channel grades varying from level to 9 inches per 100 feet, functioned throughout the period of record without overtopping or breaking. Soil losses increased when the vertical interval of 4 feet was increased to 6 feet or decreased to 2 feet. It is apparent from these data that the recommended vertical interval for terraces on Cecil soils, or soils with similar characteristics, should be held within a range close to 4 feet. The maximum length of terraces at which satisfactory performance can be secured was not determined but the satisfactory performance of a 2,000-foot terrace with 4-foot vertical and 3 inches constant grade indicates that length of graded terraces up to 2,000 feet (the maximum length tested at the station) may be governed by the availability and location of suitable outlets. Variable terrace channel grades of 0-2 inches and 0-6 inches gave satisfactory results at the station. Appreciable channel scouring and increased soil loss resulted from the 9-inch grade terraces.

Level terraces on the Cecil soil of the station tended to silt up in the channel at points where field depressions in the interterrace interval caused concentrated runoff into the channel. When heavy silt deposits occurred near the outlet ends of the terrace, ponding occurred behind the silt fan, reaching depths of 9 to 14 inches. When the silt deposits were at considerable distance from the ends of the terrace an increased gradient was established which caused damage at the outlet. It is desirable to have some grade to terraces on the common soil types of the central Piedmont area but the grade should be held to the minimum at which heavy silt accumulation in the channel will not occur. Level terracing should be confined to short terraces on soils with high rate of water intake, and with open porous subsoil. Tillage operations should be with the direction of the terraces. The number of special maintenance operations will be reduced and costs will be lower if regular tillage operations are made to contribute to the maintenance of the terraces.

Winter cover crops.—Winter cover crops not only protect cultivated land from soil losses during the winter but are particularly effective in reducing early spring losses. Since losses in this area from the spring

rainfall are approximately four times as great as those occurring during the winter period, the greatest protective value of winter cover crops may come not during the winter, but in the spring. Desirable forms of winter cover should produce enough vegetative growth not only to protect the soil while on the land, but to provide residual protective effects after the spring crop is planted. Beneficial residual effects of winter cover in decreasing soil losses on lands in cotton and corn, have been demonstrated at the station.

Rotations and cropping systems.—The development of a satisfactory cropping system involves two fundamental considerations—the protection of the land against serious soil and water losses and the maintenance of a satisfactory fertility level. In the selection of crops and in the determination of their sequence, consideration should be given to the inclusion of crop plants that will not only afford current protection but will add fertility to assure sustained production. The records at the Statesville Station show that a 4-year rotation of cotton, corn, wheat, and lespedeza has given reasonable protection over a period of 9 years but that the beneficial effects failed to carry through a 2-year period of continuous cotton immediately following 2 cycles of the rotation. On the same series of control plots continuous grass cover has been effective in reducing runoff and current soil losses and its beneficial effects have persisted after the plot was spaded and devoted to continuous cotton. It follows, therefore, that for this region the inclusion of a grass crop in the rotation is highly important.

Terrace outlets and gully control may be obtained by use of vegetative control, through grasses, honeysuckle, and kudzu, or similar types of vegetation, or through the use of mechanical structures. The use of vegetation, wherever it is practicable, is advisable because of the high cost of mechanical structures, especially those of permanent nature.

Undisturbed woods cover affords excellent control of runoff and soil loss. The control of flash runoff and the prolonged period of low flow secured from the wooded watershed, demonstrates the role that woodlands can play in the control of peak flows and in maintaining summer flows of streams to which they contribute drainage waters. Burning woodlands rapidly destroy the protective value of the woods cover in controlling soil and water losses. Semiannual burning of the woods litter caused losses to increase to rates comparable to those from cultivated areas, and to the point where the amount of soil lost per acre was many times greater than that lost from unburned woods. Excessive losses of soil and water from burned woods areas can be a very disturbing contribution to the clogging of stream channels, silting up of reservoirs, and to flood stages of the streams receiving the excess materials.

APPENDIX

In order to avoid an excess of tabular material throughout the report, the data of the individual tables necessary for deriving the summary tables and figures used in the text has been placed in this appendix as tables 27, 28, and 29.

The data here presented probably will be of little interest to the casual reader, but, as they give specific records of the results of experimentation for the period covered in the report, they will be of practical value and interest to technical readers.

Table 27.—*Highest, lowest, and mean temperature by months and by years at Statesville, N. C., 1933-40*

Year	January			February			March			April		
	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1933	76.5	14.0	47.6	82.2	6.5	42.4	79.0	18.5	48.9	86.0	34.5	57.2
1934	57.0	2.5	34.0	48.0	5.7	27.3	63.7	14.5	37.1	74.0	27.9	51.4
1935	57.0	9.2	31.7	59.6	8.7	29.9	84.0	14.3	46.9	84.9	33.0	49.3
1936	63.1	.4	34.2	77.6	3.8	35.9	76.1	29.0	51.1	91.2	23.0	55.4
1937	71.0	28.1	47.5	71.1	14.7	41.2	76.3	13.7	46.8	91.0	25.1	56.2
1938	63.3	6.0	38.5	79.0	21.0	46.1	79.0	19.7	54.6	87.3	27.3	58.5
1939	71.3	12.0	41.2	76.2	14.0	44.4	85.0	20.9	51.1	86.7	27.7	57.1
1940	56.2	−8.2	28.8	71.0	14.4	41.2	76 2	8.4	46.7	87.1	25.6	58.2
Period	76.5	−8.2	38.0	82.2	3.8	38.6	85.0	8.4	48.1	91.2	23.0	55.4

Year	May			June			July			August			September		
	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1933	98.0	44.0	71.2	104.5	41.9	78.5	102.2	46.2	78.6	99.2	55.5	78.3	97.9	42.0	75.4
1934	88.9	43.0	61.1	89.0	56.0	71.1	96.5	66.0	74.8	89.9	59.0	72.5	91.0	48.9	67.9
1935	84.9	36.3	61.9	96.9	48.1	72.8	90.0	59.2	72.5	96.5	49.7	76.0	95.6	42.2	68.8
1936	97.4	41.2	70.4	101.5	44.8	76.1	103.9	55.8	81.4	100.0	50.1	78.2	95.4	41.9	73.2
1937	97.0	37.7	67.3	98.7	56.8	77.7	99.8	52.5	77.7	97.0	61.2	78.8	94.0	43.5	67.7
1938	94.8	44.0	67.9	91.1	50.6	69.0	94.8	53.5	76.1	100.2	56.4	78.9	97.3	37.6	72.9
1939	94.0	33.0	67.4	98.7	60.1	79.4	99.7	55.2	78.7	97.5	56.5	77.7	105.0	48.3	74.0
1940	97.7	32.8	67.0	98.2	47.4	76.6	103.1	52.1	77.3	96.1	52.2	76.4	97.1	34.5	69.2
Period	98.0	32.8	66.8	104.5	47.4	75.3	103.9	46.2	77.1	100.2	49.7	77.2	105.0	34.5	71.1

Year	October			November			December			Annual		
	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1933	93.2	27.1	59.8	82.0	21.5	47.8	74.9	14.7	37.2	102.2	6.5	58.7
1934	85.9	25.0	53.3	63.5	18.1	41.6	53.0	10.5	31.0	96.5	2.5	52.0
1935	87.0	31.3	58.8	79.9	15.1	50.3	63.2	−2.0	32.2	96.9	−2.0	54.4
1936	83.0	27.2	61.2	77.6	14.8	46.2	63.0	21.1	41.5	103.9	.4	58.8
1937	88.9	27.2	55.5	73.0	12.0	40.9	67.4	8.0	39.3	98.7	8.0	58.2
1938	90.5	31.5	59.7	79.4	13.5	51.6	70.6	14.4	39.6	100.2	6.0	59.1
1939	92.8	30.5	63.7	78.0	20.5	46.0	71.7	11.4	41.8	105.0	11.4	60.2
1940	88.4	31.1	59.2	78.0	24.0	50.7	67.0	17.0	46.0	103.1	−8.2	58.1
Period	93.2	25.0	58.8	82.0	12.0	46.9	74.9	−2.0	38.5	......	......	.....
Average	......	......	......	......	......	......	......	......	......	100.8	3.1	57.7
54-year State average	......	......	......	......	......	......	......	......	......	109.0	−2.1	59.1

Table 28.—*Rains causing runoff on control plot No. 4 (bare hard fallow) and runoff and soil loss*[1] *from all control plots, Statesville, N. C., 1931-40*

Period	Rainfall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
		Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	In.	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*
1931:																									
April	1.13	...	...	...	...	...	...	0.09	0.07	...	...	...	...	...	...	0.17	0.11	...	...	...	...	...	...	...	...
May	4.71	0.24	1.49	0.21	1.87	0.20	1.74	1.22	5.94	0.55	1.14	1.53	0.74	1.82	1.35	.25	.23	1.72	1.16	0.43	0.72	0.21	0.62	0.42	1.02
June	1.84	.06	.17	.03	.18	.04	.16	.51	4.96	.14	.29	.13	.04	.24	.07	.19	.36	.43	.20	.19	.78	.15	.97	.22	1.15
July	5.62	.74	5.49	.59	3.65	.69	5.20	2.89	25.20	1.21	3.07	.57	.03	.74	.06	1.49	5.59	2.27	.80	1.39	5.46	1.47	10.32	1.36	4.90
August	8.67	2.08	8.50	2.01	8.63	1.77	10.07	4.17	21.06	3.24	9.93	1.70	.00	2.02	.00	2.62	5.28	2.03	.00	2.18	4.35	1.87	5.83	2.39	5.65
September	1.44	.42	1.29	.50	3.75	.39	3.05	.80	5.01	.62	2.78	.09	.00	.13	.00	.33	.30	.02	.00	.22	.49	.26	.49	.37	.84
October	1.12	.07	.11	.10	.31	.07	.11	.35	.86	...	...	...	...	...	...	.07	.00	...	...	.02	.00	.01	.00	.07	.00
December	7.75	1.26	.50	1.24	1.49	.04	.00	2.84	2.04	.28	.15	.13	.00	.29	.00	1.10	.09	.01	.00	.73	.11	.44	.07	1.23	.23
Annual total[2]	32.28	4.87	17.98	4.68	20.27	3.20	20.58	12.87	66.61	6.04	17.88	4.15	.96	5.24	1.67	6.22	12.52	6.48	2.38	5.16	12.42	4.41	18.74	6.06	14.57
1932:																									
January	5.21	1.13	1.15	1.19	2.71	.17	.12	1.53	3.14	.74	.84	.21	.00	.31	.00	1.05	.31	.09	.00	.78	.55	.51	.35	1.16	.60
February	1.21	.07	.00	.07	.00	.03	.00	.13	.00	.04	.00	...	...	...	...	.07	.00	...	...	.07	.00	.03	.00	.10	.00
March	5.55	.00	.00	.00	.00	.44	.25	2.00	6.79	.66	.77	.21	.00	...	...	.00	.00	.32	.00	.02	.02	.02	.00	.02	.00
April	1.79	...	...	...	...	...	...	.23	.43	.11	.04	...	...	...	...	...	...	...	...	...	...	.00	.00	...	...
May	2.30	...	...	...	...	...	...	.91	2.99	.61	.37	.03	.00	...	...	.01	.00	.02	.00	.01	.00	.00	.00	.01	.00
June	3.24	.01	.00	.01	.00	.01	.00	1.49	10.33	.94	.64	.04	.00	...	...	.02	.01	.04	.00	.03	.01	.02	.01	.03	.01
July	2.33	...	...	...	...	.00	.00	1.04	6.74	.63	.27	...	...	...	...	.02	.00	...	...	.01	.00	.01	.00	.01	.00
August	4.94	.47	3.01	.31	1.99	.30	1.58	2.65	18.17	2.28	.23	...	...	.73	1.85	1.19	4.84	.06	.00	.69	3.72	.67	4.87	.98	6.21
October	9.60	1.20	3.01	.11	.00	1.25	.85	5.51	6.79	1.27	.01	...	...	.92	.39	.03	.00	.01	.00	.64	.33	.46	.36	1.65	1.17
November	6.55	.58	.36	.14	.00	.52	.36	2.85	1.90	.88	.00	.00	.00	.41	.22	.10	.02	...	...	.55	.32	.21	.08	.79	.22
December	2.46	.02	.00	.02	.00	.03	.00	.18	.09	.04	.00	.04	.00	.03	.00	.05	.00	.03	.00	.05	.00	.04	.00	.08	.00
Annual total[2]	45.18	3.48	7.73	1.85	4.83	2.75	3.32	18.52	58.50	8.20	3.40	.53	.02	2.40	2.57	2.54	5.34	.57	.03	2.84	5.10	1.97	5.78	4.83	8.54
1933:																									
February	1.20	...	...	...	...	...	...	.04	.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
March	3.04	.02	.00	.28	1.11	.02	.03	1.25	10.91	.33	.06	...	...	.06	.11	.95	5.72	...	...	.03	.06	.01	.03	.04	.08
April	1.94	.00	.03	.00	.00	.00	.00	.45	4.78	.12	.00	...	...	.03	.12	.11	.28	...	...	.04	.05	.00	.01	.02	.08
May	4.02	.05	.28	.05	.20	.04	.17	1.57	13.69	.49	.13	.01	.03	.19	.71	.95	2.80	...	...	.23	.92	.05	.18	.14	.88
June	1.04	...	...	...	...	...	...	.34	3.33	.02	.00	...	...	...	...	.06	.07	...	...	...	...	...	...	...	...
July	4.02	.48	3.08	.04	.13	.34	2.54	2.02	12.64	.27	.02	.31	.48	.58	2.63	.93	.97	...	...	.75	4.12	.52	2.82	.78	3.59
August	4.69	1.98	18.90	.55	1.63	1.31	15.00	3.04	20.63	.97	.04	1.82	7.14	2.27	14.33	2.30	1.67	.00	.00	2.27	17.06	1.87	15.26	2.57	13.18
September	2.03	.58	3.24	.07	.10	.46	2.48	1.01	4.01	.11	.00	.45	.89	.67	3.02	.54	.07	...	...	.58	1.99	.50	1.76	.76	1.87
November	1.27	...	...	...	...	...	...	.02	.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
December	2.34	...	...	...	...	...	...	.50	.18	...	...	.00	.00	.01	.00	.00	.00	...	...	.02	.00	.01	.00	.01	.00
Annual total[2]	25.59	3.11	25.81	.99	3.24	2.17	20.40	10.24	71.15	2.31	.29	2.59	8.70	3.81	21.23	5.84	11.85	.00	.00	3.92	24.55	2.96	20.32	4.32	20.17

1934:																									
January	.58	.....	.....	.....	.....	.....	.....	.02	.00	.....	.....	.....	.....	.00	.00	.01	.00	.....	.....	.00	.00	.00	.00	.00	.00
February	3.41	.01	.00	.01	.00	.00	.00	.02	.01	.00	.00	.01	.00	.02	.01	.01	.00	.00	.00	.02	.00	.01	.00	.00	.00
March	5.02	.02	.01	.02	.01	.01	.01	.59	1.76	.01	.00	.04	.02	.12	.48	.00	.00	.00	.00	.04	.01	.01	.02	.02	.00
April	2.90	.01	.03	.03	.09	.....	.....	.71	1.91	.01	.00	.09	.15	.09	.20	.....	.....	.....	.....	.09	.14	.06	.12	.09	.40
May	3.52	.01	.00	.01	.00	.00	.00	.44	1.10	.....	.....	.00	.00	.12	.10	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00
June	1.86	.21	4.78	.17	2.86	.02	.24	.77	9.26	.20	1.09	.....	.....	.56	1.88	.01	.01	.01	.00	.35	1.03	.35	.98	.44	4.21
July	4.20	.40	3.05	.33	1.91	.07	.24	1.56	10.04	.48	1.15	.55	3.68	.78	1.20	.00	.00	.00	.00	.68	6.10	.60	8.04	.71	4.10
August	4.91	.81	11.07	.61	4.69	.05	.13	2.67	14.03	.82	2.78	.84	5.19	1.06	.14	.00	.00	.00	.00	1.02	7.55	.86	8.91	1.00	8.41
September	4.12	.66	3.07	.45	1.22	.06	.04	1.88	4.93	.52	1.24	.03	.10	.40	.05	.00	.00	.00	.00	.80	2.45	.54	2.41	.91	2.01
October	4.34	.59	1.10	.03	.01	.11	.15	2.35	2.93	.31	.33	.01	.00	.56	.32	.01	.00	.00	.00	.63	.70	.47	.60	.94	.92
November	2.73	.14	.26	.03	.01	.07	.08	1.18	2.14	.09	.10	.03	.01	.13	.01	.00	.00	.00	.00	.17	.14	.09	.06	.15	.12
December	2.75	.23	2.74	.14	.33	.22	.35	1.12	3.23	.51	.70	.30	1.18	.57	.10	.02	.00	.00	.00	.29	1.12	.41	.78	.55	.75
Annual total	40.34	3.08	26.11	1.83	11.13	.61	1.24	13.31	51.34	2.95	7.39	1.90	10.32	4.41	4.49	.06	.01	.01	.00	4.10	19.24	3.40	21.92	4.81	20.93
1935:																									
January	2.27	.....	.....	.00	.00	.00	.00	.11	.24	.....	.....	.01	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.....	.....
February	2.10	.00	.00	.00	.00	.00	.00	.07	.19	.00	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
March	8.04	.78	8.94	.34	.34	.48	3.99	2.62	24.12	1.53	18.83	2.02	7.91	.66	.71	.53	7.01	.01	.01	1.30	7.78	1.35	10.49	1.19	10.65
April	2.80	.07	.12	.20	.00	.10	.12	1.04	1.26	.67	1.82	.01	.01	.12	.01	.45	.79	.00	.00	.59	1.92	.26	1.03	.49	1.51
May	2.32	.01	.02	.00	.00	.00	.01	.41	.94	.03	.07	.02	.01	.03	.02	.01	.01	.00	.00	.01	.03	.01	.01	.01	.05
June	.40	.....	.....	.....	.....	.....	.....	.02	.05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
July	9.54	2.93	26.48	1.08	3.90	2.47	21.46	4.80	36.90	3.32	23.06	3.94	3.07	1.84	.03	3.75	28.17	.00	.00	3.87	39.09	3.75	36.86	4.14	36.86
August	.88	.01	.16	.01	.02	.03	.17	.17	1.00	.12	.56	.01	.01	.....	.....	.00	.00	.00	.00	.00	.00	.03	.14	.....	.....
September	2.48	.20	.78	.03	.02	.19	.27	.59	1.24	.42	.76	.01	.01	.....	.....	.02	.02	.....	.....	.10	.10	.13	.25	.03	.05
October	1.49	.23	.82	.06	.09	.01	.01	.42	2.52	.....	.....	.04	.03	.02	.01	.08	.15	.....	.....	.16	.15	.11	.09	.07	.07
November	3.44	1.37	3.21	.85	.94	.33	.62	1.74	6.76	.48	1.09	.72	.19	.23	.02	.89	2.02	.00	.00	1.05	1.05	.87	.88	.84	1.51
Annual total	35.76	5.60	40.53	2.39	5.36	3.61	26.65	11.99	75.22	6.55	46.19	6.79	11.26	2.91	.80	5.73	38.17	.02	.02	7.08	50.12	6.51	56.75	6.76	50.70
1936:																									
January	11.29	.80	5.68	.34	1.41	.23	.83	1.13	8.04	.69	2.06	.27	.25	.07	.01	.25	1.07	.04	.00	.24	.56	.15	.29	.24	.60
March	5.31	.84	4.05	.68	1.44	.27	.17	1.56	6.96	.58	.50	.30	6.90	.05	.02	.73	3.26	.02	.01	.66	3.08	.51	1.94	.88	2.18
April	5.31	1.74	8.24	1.60	6.04	1.21	.83	2.03	13.66	1.68	1.10	1.37	1.35	.42	.18	2.61	9.22	.01	.00	1.52	9.70	1.13	9.86	1.81	7.55
June	3.65	.13	.76	.49	2.09	.31	2.28	1.50	7.66	.56	.18	.70	.92	.48	2.52	.52	3.06	.00	.00	.49	4.11	.50	3.48	.60	3.25
July	3.56	.01	.00	.02	.02	.01	.01	1.13	2.06	.29	.06	.25	.04	.02	.02	.....	.....	.....	.....	.01	.01	.01	.01	.....	.....
August	7.07	1.55	3.73	1.66	4.04	.17	.21	4.17	17.83	2.92	.22	2.75	.32	2.20	4.37	2.02	4.33	.00	.00	2.09	4.96	1.97	5.52	1.94	4.51
September	3.63	.65	1.43	.65	.80	.05	.02	1.52	3.51	.37	.03	.13	.01	.77	.79	.11	.42	.....	.....	.81	1.59	.66	1.31	1.09	1.56
October	5.21	1.75	4.73	.17	.15	.69	.40	2.65	6.02	1.03	.05	.71	.04	1.55	1.46	.24	.28	.....	.....	1.53	2.36	1.08	1.23	1.97	2.36
November	.85	.00	.00	.....	.....	.00	.00	.05	.07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
December	4.89	.06	.05	.05	.01	.03	.01	.70	1.28	.04	.01	.04	.00	.01	.01	.09	.08	.00	.00	.03	.01	.02	.00	.05	.02
Annual total	50.77	7.55	28.67	5.69	16.00	3.00	4.76	16.46	67.09	8.17	4.21	6.53	9.83	5.59	9.38	6.58	21.72	.08	.01	7.50	26.38	6.04	23.64	8.59	22.03
1937:																									
January	8.55	1.42	1.28	1.37	.34	1.44	1.48	3.35	3.90	.51	.03	.51	.04	1.29	1.20	2.34	1.19	.....	.....	.84	.34	.31	.10	1.13	.35
April	2.83	.03	.03	.....	.....	.03	.09	.64	2.53	.01	.00	.06	.06	.30	.39	.01	.01	.....	.....	.09	.13	.04	.04	.11	.26
May	2.53	.10	1.59	.19	1.17	.19	2.13	.74	8.[illegible]	.05	.01	.25	2.55	.33	3.54	.14	.04	.00	.00	.28	2.63	.24	2.97	.35	3.93
June	2.26	.01	.02	.01	.06	.01	.10	.77	7.78	.02	.00	.02	.11	.00	.08	.09	.05	.00	.00	.02	.15	.01	.05	.03	.27
July	3.43	1.42	29.10	1.07	9.95	1.30	22.19	2.29	23.53	.17	.00	1.35	22.88	1.60	27.40	1.33	.18	.01	.00	1.52	28.43	1.53	35.82	1.83	28.97
August	6.86	1.72	12.09	2.14	4.62	1.51	8.85	3.33	13.84	.01	.00	1.54	6.67	2.90	16.18	.54	.06	.00	.00	1.97	9.71	1.64	5.88	2.25	6.52
September	1.79	.01	.01	.01	.00	.01	.00	.10	.06	.....	.....	.....	.....	.00	.00	.00	.00	.....	.....	.....	.....	.00	.00	.....	.....
October	7.68	2.86	7.32	2.94	4.88	1.30	3.67	4.25	6.40	.08	.01	2.37	5.80	1.94	8.72	.17	.00	.00	.00	2.53	4.11	1.73	2.18	2.90	2.54
November	1.31	.19	.10	.29	.06	.07	.03	.44	.16	.00	.00	.18	.05	.25	.22	.....	.....	.....	.....	.14	.05	.04	.01	.15	.03
December	1.88	.00	.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.00	.00	.00	.00	.....	.....
Annual total	39.12	7.76	50.54	8.02	21.08	5.86	38.54	15.91	66.43	.85	.05	6.28	38.16	8.61	57.73	4.62	1.53	.01	.00	7.39	45.55	5.53	47.05	8.75	42.87

See footnotes at end of table.

Table 28.—*Rains causing runoff on control plot No. 4 (bare hard fallow) and runoff and soil loss*[1] *from all control plots, Statesville, N. C., 1931-40* (Continued)

Period	Rainfall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
		Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre	Runoff	Soil loss per acre
	In.	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*	*In.*	*Tons*
1938:																									
January	2.63	.00	.00	.00	.00	.00	.00	.00	.00	....	....	.00	.00	.00	.00	....	....	.00	.00	.00	.00	.00	.00	.00	.00
February	.82	.00	.00	.00	.00	.00	.00	....	....	....	....	....	....	.00	.00	....	....	....	....	....	....	.00	.00	....	....
March	3.56	.00	.02	.00	.02	.01	.02	.12	.57	.00	.00	.00	.01	.03	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03
April	2.17	.00	.00	.00	.01	.07	.02	.36	.83	.01	.01	.01	.01	.07	.02	.00	.00	.00	.00	.00	.01	.00	.00	.01	.03
May	4.70	.06	.17	.07	.31	.03	.14	.81	6.31	.12	.31	.07	.17	.21	.07	.00	.00	.01	.00	.12	.25	.11	.43	.16	.71
June	9.02	2.90	36.52	3.23	42.31	2.38	18.92	4.95	42.41	3.70	39.04	2.94	34.74	4.11	2.06	.01	.00	.01	.00	3.67	43.05	3.82	57.74	4.03	40.24
July	9.50	3.56	13.17	1.85	9.57	1.76	4.29	4.25	12.90	2.13	10.42	2.13	8.67	2.24	.32	.00	.00	.00	.00	2.30	13.20	2.37	19.86	2.41	9.14
August	1.73	.47	5.55	.60	5.80	.61	2.21	.87	4.54	.78	4.85	.79	.49	.70	.03	.00	.00	.00	.00	.80	8.46	.83	7.43	.78	6.15
September	.74	.00	.01	.00	.00	.00	.00	.00	.01	.00	.01	.00	.02	.00	.00	....	....	.00	.00	....	....	.00	.00	.00	.00
November	5.50	1.18	4.83	.43	1.69	1.57	4.30	2.21	5.66	1.17	3.01	.02	.01	.01	.00	.00	.00	.00	.00	1.15	1.45	.85	1.54	1.33	.61
December	3.02	.00	.01	.00	.00	.01	.01	.01	.00	.00	.00	.00	.00	....	....	....	....	....	....	.00	.00	.00	.00	.00	.00
Annual total	43.39	8.17	60.28	6.18	59.71	6.44	29.91	13.57	73.23	7.91	57.65	5.76	49.12	7.37	2.52	.01	.00	.02	.00	8.04	66.42	7.98	87.20	8.72	56.91
1939:																									
January	2.24	.00	.00	.00	.00	.00	.00	.01	.05	....	....	....	....	....	....	....	....	....	....	....	....	.00	.00	....	....
February	8.68	.88	4.69	1.49	2.78	1.23	7.12	1.77	6.59	1.17	8.07	1.28	1.13	.03	.00	.00	.00	.00	.00	.82	2.33	.59	1.43	.58	1.05
March	3.49	.03	.16	.09	.08	.03	.11	.06	.25	.02	.05	.05	.03	.00	.00	.00	.00	.00	.00	.02	.02	.00	.01	.03	.03
April	1.78	.00	.01	.00	.01	.00	.01	.00	.00	.00	.01	.00	.01	.00	.01	.00	.01	.00	.00	.00	.01	.00	.00	.00	.02
May	.85	.00	.00	.00	.00	.00	.00	....	....	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
June	2.96	.38	3.83	.50	4.81	.40	4.40	.02	.04	.60	6.68	.51	3.40	.56	3.14	.55	3.60	.00	.01	.54	2.90	.46	2.71	.48	2.06
July	6.24	1.30	11.22	1.15	9.11	.97	5.40	.23	.64	1.52	7.47	1.32	4.72	1.34	4.39	1.50	7.02	.08	.03	1.60	7.62	1.48	9.19	1.58	8.04
August	4.59	.91	2.83	1.01	2.59	.82	2.02	.40	.57	1.31	2.91	1.08	1.47	1.07	1.51	1.16	2.06	.00	.00	1.26	2.98	1.23	3.88	1.33	2.84
September	1.22	.26	1.48	.23	.94	.18	.81	.15	.21	.25	.55	.18	.29	.18	.36	.16	.27	.00	.00	.17	.25	.19	.74	.29	1.36
October	1.27	.40	1.27	.40	1.29	.36	.80	.20	.20	.39	.45	.32	.17	.35	.18	.32	.14	.01	.00	.34	.48	.35	.11	.46	1.22
November	1.24	.00	.00	.00	.00	.00	.00	....	....	.00	.00	.00	.00	.00	.00	.00	.00	....	....	.00	.00	.00	.00	....	....
December	1.91	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00
Annual total	36.47	4.16	25.49	4.87	21.61	3.99	20.67	2.84	8.55	5.26	26.19	4.74	11.22	3.53	9.59	3.69	13.10	.09	.04	4.75	16.59	4.30	18.07	4.76	16.63
1940:																									
January	1.78	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00
February	1.82	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
March	2.29	.00	.00	.00	.00	.00	.00	....	....	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	....	....
April	3.10	.00	.01	.00	.01	.00	.01	.00	.00	.03	.03	.03	.02	.02	.02	.02	.02	.00	.00	.00	.00	.00	.01	.01	.02
May	1.88	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
June	3.27	.15	.48	.28	2.20	.19	1.44	.07	.19	.45	3.55	.40	2.21	.50	3.46	.54	2.97	.13	.26	.35	1.69	.36	1.95	.50	2.44
July	2.94	.00	.01	.00	.03	.00	.01	.00	.01	.03	.12	.00	.02	.00	.02	.02	.07	.00	.00	.00	.02	.00	.01	.01	.04
August	7.51	1.74	10.47	2.01	14.85	1.72	10.65	1.50	7.82	2.17	15.08	1.82	8.91	1.83	7.77	1.98	9.85	1.21	6.37	1.94	7.70	1.67	11.01	1.49	6.84
September	2.38	.81	5.25	.89	5.69	.76	3.79	.66	2.45	.84	4.12	.67	2.70	.77	2.58	.76	2.69	.37	.99	.77	3.32	.71	4.23	.98	3.38
October	1.30	.00	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.02	.02
November	2.82	.17	.10	.31	.14	.26	.14	.08	.04	.16	.03	.14	.09	.07	.04	.06	.07	.01	.02	.17	.11	.15	.08	.24	.20
Annual total	31.09	2.87	16.32	3.50	22.93	2.93	16.04	2.31	10.51	3.68	22.93	3.06	13.95	3.19	13.90	3.38	15.67	1.72	7.64	3.23	12.84	2.89	17.32	3.26	12.95

[1]The figure .00 indicates trace quantities only.

[2]Total soil loss for the year represents soil loss in the sludge or sediment, plus the soil carried in suspension.

Table 29.—*Annual summary of rainfall, runoff, and soil loss on the control plots on Cecil sandy clay loam, Statesville, N. C.*

Plot No.[1] and year	Precipitation	Soil amendment: Amount	Soil amendment: Kind	Soil cover or crop: Winter cover[2]	Soil cover or crop: Harvested crop	Runoff: Per plot	Runoff: Depth	Runoff: Precipitation	Soil loss: Per plot	Soil loss: Per acre
PLOT 1. DESURFACED 6-INCH DEPTH. CONTINUOUS COTTON. 1/100 ACRE										
	Inches	*Pounds*				*Cubic feet*	*Inches*	*Percent*	*Pounds*	*Tons*
1931	44.98	600	5-10-3	Wheat stubble	Cotton	176.7	4.87	10.8	359.7	17.98
1932	55.28			Cotton stalks	do	126.3	3.48	6.3	154.7	7.74
1933	34.70			do	do	112.8	3.11	9.0	516.2	25.81
1934	49.34			do	do	111.6	3.07	6.2	522.2	26.11
1935	42.80			do	do	202.7	5.58	13.0	810.4	40.52
1936	60.00			do	do	274.9	7.57	12.6	574.0	28.70
1937	47.52			do	do	282.1	7.77	16.4	1,031.3	51.56
1938	47.76			do	do	246.3	6.79	14.2	1,206.4	60.32
Total	382.38					1,533.4	42.24		5,154.9	257.74
Average	47.80					191.7	5.28	11.0	644.4	32.22
PLOT 2. DESURFACED 6-INCH DEPTH. ROTATION: CORN-COWPEAS AND COTTON. FERTILIZED ANNUALLY.[3] 1/100 ACRE										
1931	44.98	400	5-10-3	Wheat stubble	Corn-cowpeas	169.7	4.68	10.4	405.4	20.27
1932	55.28	600	5-10-3	Corn stubble-pea vines	Cotton	67.0	1.84	3.3	96.7	4.83
1933	34.70	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	35.9	.99	2.8	64.8	3.24
1934	49.34	600	4-10-4	Corn stubble-pea vines	Cotton	66.3	1.83	3.7	222.6	11.13
1935	42.80	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	87.8	2.42	5.6	106.3	5.32
1936	60.00	600	4-10-4	Corn stubble-pea vines	Cotton	206.4	5.68	9.5	320.4	16.02
1937	47.52	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	291.6	8.03	16.9	421.3	21.07
1938	47.76	600	4-10-4	Corn stubble-pea vines	Cotton	225.0	6.20	13.0	1,202.3	60.12
Total	382.38					1,149.7	31.67		2,839.8	141.99
Average	47.80					143.7	3.96	8.3	355.0	17.75
PLOT 3. DESURFACED 6-INCH DEPTH. ROTATION: CORN-COWPEAS AND COTTON. FERTILIZED ANNUALLY.[3] 1/100 ACRE										
1931	44.98	600	5-10-3	Wheat stubble	Cotton	116.2	3.20	7.1	411.6	20.58
1932	55.28	400	5-10-3	Cotton stalks-rye-vetch	Corn-cowpeas	99.9	2.75	5.0	66.2	3.31
1933	34.70	600	4-10-4	Corn stubble-pea vines	Cotton	78.9	2.17	6.3	408.0	20.40
1934	49.34	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	22.3	.61	1.2	24.9	1.25
1935	42.80	600	4-10-4	Corn stubble-pea vines	Cotton	130.3	3.59	8.4	533.0	26.65
1936	60.00	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	110.1	3.03	5.1	95.5	4.78
1937	47.52	600	4-10-4	Corn stubble-pea vines	Cotton	212.9	5.87	12.3	771.3	38.57
1938	47.76	400	4-10-4	Cotton stalks-rye-vetch	Corn-cowpeas	234.8	6.47	13.5	598.5	29.92
Total	382.38					1,005.4	27.70		2,909.0	145.45
Average	47.80					125.7	3.46	7.2	363.6	18.18

Table 29.—*Annual summary of rainfall, runoff, and soil loss on the control plots on Cecil sandy clay loam, Statesville, N. C.*—(Continued)

Plot No.[1] and year	Precipitation	Soil amendment: Amount	Soil amendment: Kind	Soil cover or crop: Winter cover[2]	Soil cover or crop: Harvested crop	Runoff: Per plot	Runoff: Depth	Runoff: Precipitation	Soil loss: Per plot	Soil loss: Per acre
	Inches	Pounds				Cubic feet	Inches	Percent	Pounds	Tons
PLOT 4. FALLOW (HARD) SCRAPED TO REMOVE WEEDS 4 TIMES ANNUALLY. 1/100 ACRE										
1931	44.98			None	None	467.0	12.86	28.6	1,332.3	66.61
1932	55.28			do	do	672.4	18.52	33.5	1,170.0	58.50
1933	34.70			do	do	371.9	10.25	29.5	1,423.1	71.15
1934	49.34			do	do	482.9	13.30	27.0	1,026.8	51.34
1935	42.80			do	do	435.0	11.98	28.0	1,504.8	75.24
1936	60.00			do	do	598.3	16.48	27.5	1,342.0	67.10
1937	47.52			do	do	578.5	15.94	33.5	1,328.5	66.43
1938	47.76			do	do	493.7	13.60	28.5	1,465.1	73.25
Total	382.38					4,099.7	112.94		10,592.6	529.63
Average	47.80					512.5	14.12	29.5	1,324.1	66.20
PLOT 5. ROTATION: CORN, WHEAT-LESPEDEZA, LESPEDEZA, COTTON. 1/100 ACRE										
1931	44.98	800	5-10-3	Wheats tubble	Corn	219.2	6.04	13.4	357.7	17.88
1932	55.28			Wheat	Wheat-lespedeza	297.5	8.20	14.8	67.8	3.39
1933	34.70			Lespedeza	Lespedeza	83.7	2.30	6.6	5.8	.29
1934	49.34			do	Cotton	107.0	2.95	6.0	147.8	7.39
1935	42.80	800	4-10-4	Cotton stalks	Corn	237.8	6.55	15.3	923.0	46.15
1936	60.00			Wheat	Wheat	296.5	8.17	13.6	83.8	4.19
1937	47.52			Lespedeza	Lespedeza	31.2	.86	1.8	1.7	.08
1938	47.76	600	4-10-4	do	Cotton	288.3	7.94	16.6	1,153.6	57.68
Total	382.38					1,561.2	43.01		2,741.2	137.06
Average	47.80					195.2	5.88	11.2	342.6	17.13
PLOT 6. ROTATION: WHEAT-LESPEDEZA, LESPEDEZA, COTTON, CORN (EXCEPT NO WHEAT FOR YEAR 1931). 1/100 ACRE										
1931	44.98	400	2-10-4	Wheat stubble	Lespedeza	150.5	4.15	9.2	19.3	0.96
1932	55.28			Lespedeza	do	19.4	.53	1.0	.4	.02
1933	34.70			do	Cotton	94.2	2.59	7.5	174.1	8.70
1934	49.34			Cotton stalks	Corn	68.9	1.90	3.8	206.5	10.32
1935	42.80			Wheat	Wheat-lespedeza	246.4	6.79	15.9	225.2	11.26
1936	60.00			Lespedeza	Lespedeza	237.3	6.54	10.9	196.4	9.82
1937	47.52	600	4-10-4	do	Cotton	228.7	6.30	13.3	763.2	38.16
1938	47.76	800	4-10-4	Cotton stalks	Corn	217.0	5.98	12.5	982.7	49.13
Total	382.38					1,262.4	34.78		2,567.8	128.39
Average	47.80					157.8	4.35	9.1	321.0	16.05

See footnotes at end of table.

PLOT 7. ROTATION: LESPEDEZA, COTTON, CORN, WHEAT-LESPEDEZA. 1/100 ACRE

1931	44.98	400	2-10-4	Wheat stubble	Lespedeza	190.1	5.24	11.6	33.5	1.68
1932	55.28			Lespedeza	Cotton	87.2	2.40	4.4	51.4	2.57
1933	34.70			Cotton stalks	Corn	138.3	3.81	11.0	424.7	21.23
1934	49.34			Wheat	Wheat-lespedeza	160.2	4.41	9.0	90.0	4.50
1935	42.80			Lespedeza	Lespedeza	106.2	2.92	6.8	16.1	.80
1936	60.00	600	4-10-4	do	Cotton	203.2	5.60	9.3	187.2	9.36
1937	47.52	800	4-10-4	Cotton stalks	Corn	312.4	8.60	18.1	1,154.9	57.75
1938	47.76			Wheat	Wheat-lespedeza	268.2	7.39	15.5	50.4	2.52
Total	382.38					1,465.8	40.38		2,008.2	100.41
Average	47.80					183.2	5.05	10.6	231.0	12.55

PLOT 8. ROTATION: COTTON, CORN, WHEAT-LESPEDEZA, LESPEDEZA. 1/100 ACRE

1931	44.98	600	5-10-3	Wheat stubble	Cotton	225.6	6.22	13.8	250.5	12.52
1932	55.28			Cotton stalks	Corn	92.0	2.54	4.6	106.9	5.34
1933	34.70			Wheat	Wheat-lespedeza	212.0	5.84	16.8	237.0	11.85
1934	49.34			Lespedeza	Lespedeza	2.1	.06	.1	.5	.02
1935	42.80	600	4-10-4	do	Cotton	207.9	5.73	13.4	763.8	38.19
1936	60.00	800	4-10-4	Cotton stalks	Corn	200.2	5.51	9.2	434.3	21.71
1937	47.52			Wheat	Wheat	167.1	4.60	9.7	30.8	1.54
1938	47.76			Lespedeza	Lespedeza	.7	.02	.0	[4].0	[4].00
Total	382.38					1,107.6	30.51		1,823.8	91.19
Average	47.80					138.4	3.81	8.0	228.0	11.40

PLOT 9. PERMANENT SOD, MIXED GRASS. 1/100 ACRE

1931	44.98	400	2-10-4	Wheat stubble	Hay	235.3	6.48	14.4	47.6	2.38
1932	55.28			Mixed grass	do	20.7	.57	1.0	.5	.02
1933	34.70			do	do	.1	[4].00	.0	[4].0	[4].00
1934	49.34			do	do	.9	.02	.0	.1	.01
1935	42.80			do	do	.8	.02	.1	.4	.02
1936	60.00			do	do	3.2	.09	.2	.4	.02
1937	47.52			do	do	1.0	.03	.1	.1	[4].00
1938	47.76			do	do	1.2	.03	.1	.1	[4].00
Total	382.38					263.2	7.25		49.2	2.45
Average	47.80					32.9	.91	1.9	6.2	.31

Table 29.—*Annual summary of rainfall, runoff, and soil loss on the control plots on Cecil sandy clay loam, Statesville, N. C.*—(Continued)

PLOT 10. CONTINUOUS COTTON, FERTILIZED ANNUALLY EXCEPT FOR PERIOD 1932-34. 1/100 ACRE

Plot No.[1] and year	Precipitation	Soil amendment		Soil cover or crop		Runoff			Soil loss	
		Amount	Kind	Winter cover[2]	Harvested crop	Per plot	Depth	Precipitation	Per plot	Per acre
	Inches	Pounds				Cubic feet	Inches	Percent	Pounds	Tons
1931	44.98	600	5-10-3	Wheat stubble	Cotton	187.4	5.16	11.5	248.3	12.42
1932	55.28			Cotton stalks	do	103.2	2.84	5.1	102.1	5.10
1933	34.70			do	do	142.3	3.92	11.3	490.9	24.54
1934	49.34			do	do	148.7	4.10	8.3	385.0	19.25
1935	42.80	600	4-10-4	do	do	257.0	7.08	16.5	1,002.2	50.11
1936	60.00	600	4-10-4	do	do	269.4	7.42	12.4	527.7	26.39
1937	47.52	600	4-10-4	do	do	268.0	7.38	15.5	911.2	45.56
1938	47.76	600	4-10-4	do	do	292.1	8.05	16.9	1,328.3	66.42
Total	382.38					1,668.1	45.95		4,995.7	249.78
Average	47.80					208.5	5.74	12.4	624.5	31.22

PLOT 11. CONTINUOUS COTTON, FERTILIZED ANNUALLY EXCEPT FOR PERIOD 1932-34. 1/50 ACRE

Plot No.[1] and year	Precipitation	Amount	Kind	Winter cover[2]	Harvested crop	Runoff per plot	Runoff depth	Runoff precipitation	Soil loss per plot	Soil loss per acre
1931	44.98	600	5-10-3	Wheat stubble	Cotton	320.0	4.41	9.8	749.6	18.74
1932	55.28			Cotton stalks	do	143.2	1.97	3.6	231.0	5.78
1933	34.70			do	do	214.9	2.96	8.5	812.9	20.32
1934	49.34			do	do	246.7	3.40	6.9	877.1	21.93
1935	42.80	600	4-10-4	do	do	474.7	6.54	15.3	2,269.3	56.73
1936	60.00	600	4-10-4	do	do	439.2	6.05	10.1	947.4	23.69
1937	47.52	600	4-10-4	do	do	405.1	5.58	11.7	1,880.8	47.02
1938	47.76	600	4-10-4	do	do	502.8	8.03	16.8	3,497.3	87.43
Total	382.38					2,826.6	38.93		11,265.4	281.64
Average	47.80					353.3	4.87	10.2	1,408.2	35.20

PLOT 12. CONTINUOUS COTTON, FERTILIZED ANNUALLY EXCEPT FOR PERIOD 1932-34. 1/200 ACRE

Plot No.[1] and year	Precipitation	Amount	Kind	Winter cover[2]	Harvested crop	Runoff per plot	Runoff depth	Runoff precipitation	Soil loss per plot	Soil loss per acre
1931	44.98	600	5-10-3	Wheat stubble	Cotton	110.0	6.06	13.5	145.6	14.56
1932	55.28			Cotton stalks	do	87.7	4.83	8.7	85.4	8.54
1933	34.70			do	do	78.4	4.32	12.4	201.7	20.17
1934	49.34			do	do	87.3	4.80	9.7	209.4	20.94
1935	42.80	600	4-10-4	do	do	122.8	6.76	15.8	506.9	50.69
1936	60.00	600	4-10-4	do	do	156.2	8.60	14.3	220.6	22.06
1937	47.52	600	4-10-4	do	do	158.4	8.73	18.4	428.6	42.86
1938	47.76	600	4-10-4	do	do	158.7	8.74	18.3	569.2	56.92
Total	382.38					959.5	52.86		2,367.4	226.74
Average	47.80					119.7	6.60	13.8	295.9	29.59

See footnotes at end of table.

PLOT A. VIRGIN WOODS, UNDISTURBED. 1/100 ACRE

1932	55.28	....	Virgin forest	None	3.9	0.11	0.2	0.1	[4].00
1933	34.70	....	do	do	2.5	.07	.2	[4].0	[4].00
1934	49.34	....	do	do	1.6	.04	.1	[4].0	[4].00
1935	42.80	....	do	do	.1	[4].00	.0	[4].0	[4].00
1936	60.00	....	do	do	.1	[4].00	.0	[4].0	[4].00
1937	47.52	....	do	do	.5	.01	.0	.1	[4].00
1938	47.76	....	do	do	.2	[4].00	.0	[4].0	[4].00
1939	42.34	....	do	do	[4].0	[4].00	.0	[4].0	[4].00
1940	38.45	....	do	do	[4].0	[4].00	.0	[4].0	[4].00
Total	418.19	....	....	....	8.9	.236	....	.36	.0175
Average	46.47	....	....	....	1.0	.026	.056	.04	.0019

PLOT B. VIRGIN WOODS, LITTER BURNED SEMIANNUALLY. 1/100 ACRE

1932	55.28	....	Forest	None	5.9	0.16	0.3	0.2	0.01
1933	34.70	....	do	do	4.4	.12	.4	.7	.03
1934	49.34	....	do	do	55.7	1.54	3.1	20.8	1.04
1935	42.80	....	do	do	168.3	4.64	10.8	29.1	1.45
1936	60.00	....	do	do	301.3	8.30	13.8	78.0	3.90
1937	47.52	....	do	do	312.1	8.60	18.1	79.4	3.97
1938	47.76	....	do	do	359.4	9.90	20.7	156.2	7.81
1939	42.34	....	do	do	325.8	8.98	21.2	125.9	6.30
1940	38.45	....	do	do	225.8	6.22	16.2	64.2	3.21
Total	418.19	....	....	....	1,758.7	48.46	....	554.4	27.72
Average	46.47	....	....	....	196.1	5.38	11.51	61.6	3.08

[1]All plots have a uniform 10-percent slope, and a uniform length of 72.6 feet except plot 11, which is 145.2 feet, and plot 12, which is 36.3 feet. Plots bearing row crops are plowed in spring prior to planting of row crops. All row crops are planted across slope and cultivated (smooth culture) during growing season as customary practice. Wheat is planted in fall following disking of corn stubble and lespedeza sown in wheat in early spring. Cowpeas are sown in growing corn in early summer.

[2]Winter cover refers to portion of the calendar year preceding planting of the harvested crop.

[3]Fertilized semiannually preceding planting; 400 pounds for corn crop and 400 pounds for wheat crop.

[4]Indicates trace quantities only.

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